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Preliminary Analysis Report

Prepared by
Wesley Grimes

RE:

Bryson v. Rough Country, LLC

Mecanica Case Number: 22-3104
Date of Collision: March 15, 2020

Location of Crash:
Intersection of Georgia 2 and Georgia 5
Blue Ridge, Fannin County, Georgia

Report Prepared For:

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Report Date:
March 27, 2024

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List of Qualifications

The analysis, as described in this report, has been completed by Wesley D. Grimes, P.E. and includes some work by personnel at Mecanica Scientific Services under his direction. Below is a summary of qualifications, for a complete list, please see attached CV in Appendix C.

- Bachelor of Science degree from Arizona State University;
- Licensed professional engineer in Arizona and Louisiana;
- Involved in the field of accident reconstruction for over 40 years;
- Very active in this scientific community as a session co-organizer for SAE (Society of Automotive Engineering) World Congress for sessions involving accident reconstructions for 10 years, including topics such as: crash modeling, vehicle dynamics, crush energy calculations, roll overs, heavy-truck crash analysis, computer modeling of vehicle crashes, photogrammetry, etc.;
- Taught courses in accident reconstruction for over 20 years, including advanced classes.
- Published more than 25 treatises in this field;
- Qualified to testify in federal and state courts, including (but not limited to): Arizona, Alabama, Florida, Texas, Oregon, New Mexico, Illinois, Pennsylvania, Ohio, Indiana, Michigan, Minnesota;
- Attended many courses for continuing education in this field, including (but not limited to): 3-d modeling, photogrammetry, low-speed crashes, heavy-truck crash analysis, air bag systems, side impacts, CDR training, ECM download training, etc;
- Member of several organizations relating to accident reconstruction and analysis, such as: SAE, AAAM (Association for the Advancement of Automotive Medicine), Committee On Accident Investigation and Reconstruction Practices (1984-2011), NAPARS (National Association of Professional Accident Reconstructionists).

Items Obtained and Reviewed

- Scene photographs
- 2008 Ford Escape photographs
- 2016 Ford F-250 photographs
- Aerial photographs of scene
- Exponent crash test report for 2016 Ford F-250 into a 2008 Ford Escape, TEC2210759, including Exponent crash test videos and pre-test and post-test FARO three-dimensional scans of the test vehicles.
- GDPS (Georgia Department of Public Safety) scene photographs
- GDPS aerial mosaic photograph
- Plaintiff's Responses To Defendant Interrogatories, dated Feb., 1, 2023
- Supplement to Plaintiffs' Initial Disclosures, dated October 16, 2023.
    - Report of G. Bryant Buchner, dated October 12, 2023.

  - Report of Christopher Roche, dated October 12, 2023.
  - Report of Paul Lewis, Jr., dated October 16, 2023.
- Joint inspection sign-in sheet dated December 13, 2022
- Stipulated Confidentiality Agreement and Protective Order, dated September , 23, 2022
- Ronnie Thompson Ford Verification of Authenticity
- SAE *Automotive Engineering,* December 2022
- Georgia State Patrol Specialized Collision Reconstruction Team, #SCRTB-017-20, March 15, 2020
- Georgia State Patrol Specialized Collision Reconstruction Team, #SCRTB-017-20, Summary
- Traffic Crash Reconstruction, L. Fricke, Northwestern University Traffic Institute, 2010
- Quest Engineering & Failure Analysis - SIMON Simulation data
- Vehiclemetrics ASCII code
- Buchner - Vehicle crush diagrams, calculations and reference material
- Buchner Materials
  - Engineering Analysis folder
    - Point cloud engagement images
    - Ford Escape point cloud AVI files
    - Car Seat Location PowerPoint slides
    - Car Seat Measurement PowerPoint slides
    - Engineering analysis documents
    - Ford F250 tire photos and tire and loading placard
    - Buchner report
    - Buchner report support documents
    - Accident Report Diagram Summary
    - 10519 Scene.kmz file
    - Base Data Summary
    - Base scene with officer paint image
    - F250 ACM Summary spreadsheet
    - Match Points with measurements PowerPoint slides
  - Aerials
  - Correspondence
  - EDR
    - Ford F250 ACM Download summary, CDRx and CSV files
    - EDR Sign Convention image
    - Ford F250 Download summary spreadsheet plots
    - Ford Escape Veoneer RCM Download results
    - Ford F250 Infotainment Download
  - Car Seat
    - Photos
    - Evidence intake, release and shipping information
  - Field Work

        - Jeff Kidd notes and diagrams
    - Law Enforcement
        - SCRT Report, photos and MP4 files
        - Fannin County Crash Report
        - Georgia DPS NIBRS Incident Report
        - Georgia Troop B Call History Record
    - Cohan Bryson, Joshua Bryson and Kelley Santanna medical records and photos
    - Photos and videos
        - Client RC Production Fannin DA videos
        - DOA Police bodycam videos
        - Police photos
        - Ford Escape photos
        - Ford F250 photos
        - Aerial and ground site photos
    - Sent to client files
    - Scan registration files and point cloud images
    - Technical reference material
- Depositions
    - Eisenstat deposition and exhibits
    - Roche deposition and exhibits
    - Santana Bryson deposition and exhibits
    - Joshua Bryson deposition and exhibits
    - Bryant Buchner deposition and exhibits
    - Hunsley deposition and exhibits
    - Trooper Phillips deposition and exhibits
- Autopsy images of Cohan Bryson
- Paul Lewis report
- Lewis exemplar Ford Escape photos
- Lewis subject Ford Escape photos
- Bioforensic Consulting invoice #0147
- Paul Lewis C.V. and Rule 26 list
- NIAR Report No. CDL-TH23B-01-01
- Calspan CAL3490 - Tracy Law Test 6 - 59 mph Rear Impact
- Calspan Injury Summary: CAL3490
- NIAR Report No. C
- Joint inspection sign-in sheet
- NDA stipulation, dated Sept. 23, 2022
- Loftland verification of authenticity for Ronnie Thompson Ford documentation
- SAE Automotive Engineering, December 2022 pdf

Items Produced by Mecanica Scientific Services

- Google Earth Pro image of scene location
- Inspection of the collision site was performed on December 12, 2022, in Blue Ridge, Georgia. During the inspection, site drive-through videos and photographs were taken.
- Inspection of the Ford F-250 and Ford Escape were performed on December 13, 2022, in Covington, Georgia. The vehicles were inspected, photographed, measured, and scanned using a FARO three-dimensional scanner.
- Point clouds were created from the FARO high definition scans of Ford F-250 and Ford Escape
- Vehicle specifications and VIN decode for 2016 Ford F-250 VIN 1FT7W2BT9GEC79140
- Vehicle specifications and VIN decode for 2008 Ford Escape VIN 1FMCU03178KA77952.
- SAE Technical Paper 2001-01-1170, J. Croteau, S. Werner, J. Habberstad, J. Golliher, “Determining Closing Speed in Rear Impact Collisions with Offset and Override, SAE International.
- SAE Technical Paper 2014-01-0496, M. Wood, N. Earnhart, and K. Kennett, “Airbag Deployment Thresholds from Analysis of the NASS EDR Database, SAE International.

Vehicle/Driver Information

- 2016 Ford F-250, driven by Hunter Elliott
  - VIN 1FT7W2BT9GEC79140
  - Passengers: none
- 2008 Ford Escape, driven by Santana Sheree Kelley
  - VIN 1FMCU03178KA77952
  - Passengers: Joshua Bryson (RF)
Cohen Bryson (LR)

General Event Summary

On March 15, 2020, a two-vehicle collision occurred at the intersection of Georgia State Route 2 and Georgia State Route 5 in Fannin County, Georgia. At approximately 11:15 p.m., the front of a 2016 Ford F-250 pickup, driven by Mr. Hunter Elliott, impacted the rear of a 2008 Ford Escape, driven by Ms. Santana Kelley. Mr. Elliott was driving westbound on Georgia 2 when the collision occurred. Ms. Kelley was stopped at the red traffic signal in the left westbound lane on Georgia 2 at the intersection with Georgia 5. Mr. Joshua Bryson was a passenger in the right-front seat of the Escape. Mr. Cohen Bryson was also a passenger in the Escape, seated in a forward-facing car seat behind the driver’s seat. Ms. Kelley was pregnant at the time of this incident. Mr. Cohen Bryson was fatally injured during this incident.

Scope of Analysis

Mecanica was contacted to review documents, inspect and document the crash site, the F-250 pickup and the Escape, and complete an accident reconstruction analysis of the crash, if possible. As part of the analysis, calculations utilizing the data in the CDR Report were performed using methodologies normally performed in the field of vehicular collision reconstruction. A two-vehicle crash test was performed using exemplar vehicles.

Site Information

Georgia State Route 2 (Georgia 2) in the vicinity of the collision was a five-lane, asphalt roadway with two through lanes in each direction and a center turn lane, oriented in an east/west direction. The roadway also had right-turn lanes before and after the intersection with Georgia State Route 5. Approximately 360 feet east of the intersection, Georgia 2 travel directions were separated by a soil median. The overall location of this collision is shown in **Figure 1** utilizing mapping data from GoogleEarth Pro (Ver. 7.3.6.9345). The speed limit on Georgia 2 was 45 mph.

Georgia State Route 5 (Georgia 5) at the intersection with Georgia 2 was a three-lane, asphalt roadway with one through lane in each direction and a center turn lane. North and south of the intersection, each direction had a right-turn lane. The northbound traffic had a merge lane north of the intersection. Georgia 5 intersected Georgia 2 at approximately 48 degrees (**Figure 1**). There were no lights illuminating the intersection shown in the GDPS photographs. The vehicle movements at this intersection were controlled by traffic signals. This collision was documented by the Georgia Department of Public Safety in Georgia Motor Vehicle Crash Report (GaCR) with agency case number C000671920-01, prepared by Officer Matheson (Badge No. 0650).

According to the Georgia State Patrol Specialized Collision Reconstruction Team (SCRT) Report, at the time of the crash, it was cloudy, the roadway was dry, and it was dark, but lighted. Neither Georgia 2 nor Georgia 5 had artificial lighting (light poles) near the intersection.

Figure 2 is an orthomosaic created from drone aerial photographs of the site showing a close-up of the intersection. In the orthomosaic (**Figure 3**) the police markings indicating the rest positions of the vehicles were observed. From the SCRT Report, the F-250 was moved after it originally came to rest. The police report identified the collision site as 25 feet east of Blue Ridge Drive on Georgia 2.

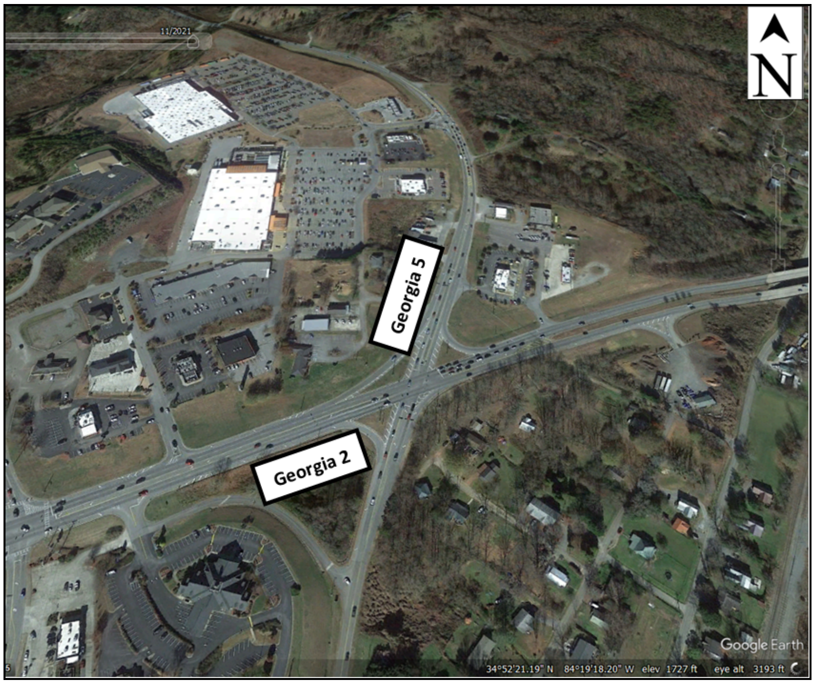


Figure 1: GoogleEarth Pro image of collision location
Note that GoogleEarth Pro lists Georgia 2 as 76

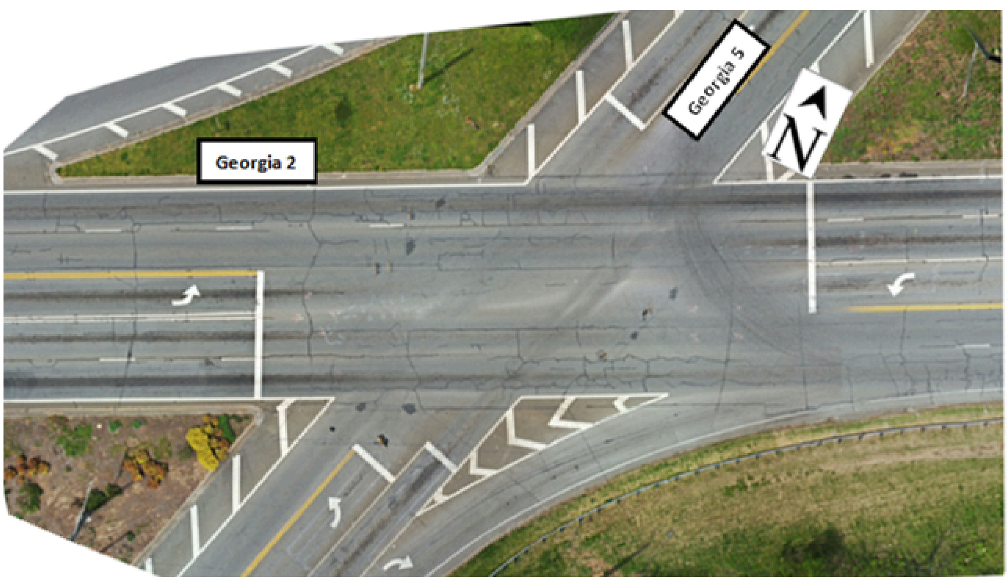


Figure 2: Aerial mosaic from GDPS

Figure 3: GDPS aerial view with points of rest marked

Vehicle Information and Damage

2016 Ford F-250

This 4-door, crew cab pickup was equipped with a 6.7-liter, V8, diesel engine, automatic transmission, four-wheel drive, front and side airbags, power front seats, power windows, LT325/50R22 Nitto tires, Roll-N-Lock bed cover, and an aftermarket lift kit. After the collision, the truck had a Greenlee tool box, chain saw, and a gas can in the cargo bed. Inside the cab of the vehicle were clothes, a hard hat, a forward-facing child car seat, tools, boxes, and several cases of beer and individual beer cans. It is not known what was in the boxes or whether the beer cans were full or empty from the photographs. The driver seat belt appeared to be locked in the stowed position.

The aftermarket lift kit from Rough Country was installed on the F-250 before this incident. The kit included coil springs, radius arm drop brackets, sway-bar drop brackets, track bar drop brackets, stabilizer relocation brackets, pitman arm, brake lines, brake line brackets, shock absorbers, bump stop spacers, lift blocks, U-bolts, and attachment hardware (**Figures 4 and 5**). In addition, the pickup had a steering stabilizer and larger tires and wheels than original equipment.

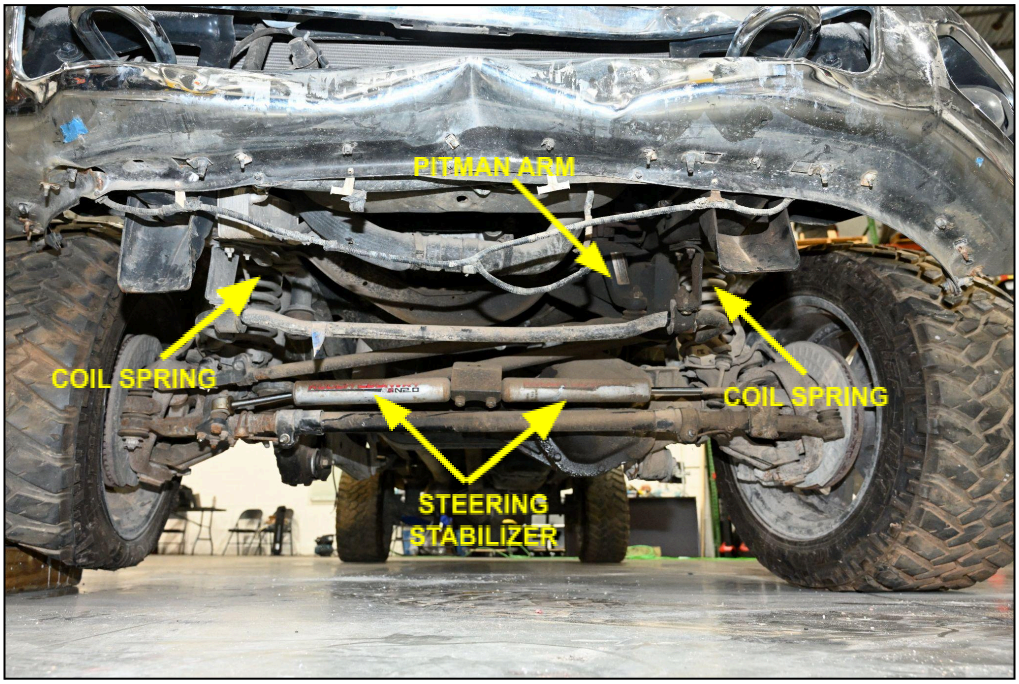


Figure 4: Front underbody of F-250 showing various aftermarket components

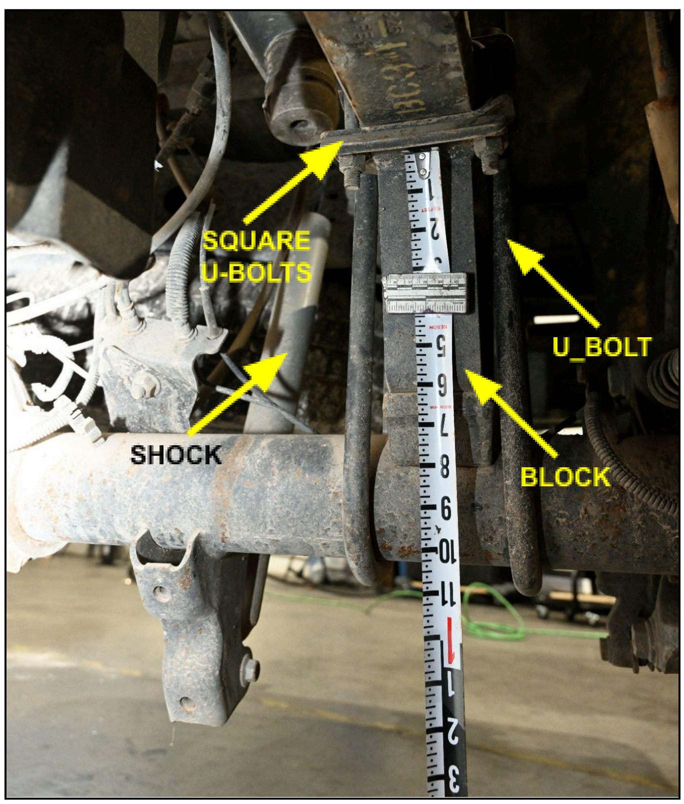


Figure 5: Rear underbody of F-250 showing aftermarket components

The right side of the bumper was distorted rearward and upward. The center grill had fractures, but was largely intact. Both headlamp assemblies were missing. The hood was displaced rearward and buckled across its top surface.

There were blue and white markings on the right corner of the bumper (**Figure 6**).

Figure 6: Ford F-250 right corner of the front bumper

The right side of the vehicle had two horizontal scratches from the front of the right-front door to the rear of the right-rear door (**Figure 7**). However, these scrapes could not be clearly seen in the police photos (**Figure 8**) and there appears to be dried mud sprayed up over them, indicating they likely did not come from this incident.

Figure 7: Right front of Ford F-250 showing scratches on right side of vehicle

Figure 8: Police photo showing no scratches on right side of vehicle

The bottom of the right Secondary Energy Absorption System (SEAS) was displaced rearward, see **Figure 9**. The left SEAS is angled with the bottom portion slightly forward. The left side of the windshield was fractured. The left edge of the front bumper is rotated downward. The left

front tire was rotated to the left. There were vertical scrape marks on the trim above the left front tire (**Figure 10**). The rear of the vehicle appeared undamaged.

Figure 9: Front of Ford F-250 - right SEAS bracket displaced rearward

Figure 10: Left front of Ford F-250

The Ford's ACM is capable of recording crash data during some collision events. There are two types of events: non-deployment and deployment events. Non-deployment events occur when

the recording threshold is met, but no airbags are commanded to deploy. Non-deployment events can be overwritten. Deployment events are locked and cannot be overwritten. The ACM records five seconds of pre-crash data in addition to crash data. The ACM can store up to 2 events.

The F-250's airbag control module (ACM) was downloaded by Corporal J. Allison of the Georgia State Patrol on March 17, 2020. In the Comments section, the recommended tire size was LT275/65R20 and the installed tire size was LT325/50R22. The CDR report indicated the ignition cycles at the time of the crash and download were 6,697 and 6,698, respectively. In the CDR report one diagnostic trouble code (DTC) was present at the start of the event. According to dtcdecode.com, the DTC is set when the body control module (BCM) has permanently disabled an output because an excessive current draw fault, such as a short to ground, has exceeded the limits the BCM can withstand. The Deployment data indicated the maximum longitudinal change in velocity (delta-V) as -18.21 mph and the maximum lateral delta-V as -0.76 mph. The Pre-Crash data (-1 sec) indicated the driver seat belt was not buckled.

The indicated speed of the F-250 at Time 0 (algorithm enable) was 50 mph. The accelerator pedal was applied until Time 0 between 23 percent and 24 percent. At Time 0, the accelerator pedal percentage went to zero and the service brake was ON. Prior to Time 0, the service brake was off. The ABS was not engaged for the five seconds prior to impact. The lateral acceleration, longitudinal acceleration, yaw rate and roll rate from the stability control were relatively constant for the five seconds prior to Time 0.

The post-crash data recorded for approximately 250 milliseconds (ms). From these data, the maximum longitudinal delta-V was -18.16 mph, the maximum lateral delta-V was -0.73 mph, and the maximum roll angle was -5.76 degrees. According to 49 CFR 563, the end of event time means the moment at which the cumulative delta-V within a 20 ms interval becomes 0.5 mph or less. For this crash, the end of the event was approximately 141 ms after Time 0. At 141 ms, the longitudinal delta-V was -17.48 mph and the lateral delta-V was -0.40 mph.

It is generally accepted in the accident reconstruction community that ACM speed data is accurate to at least +/- four percent (4%) and that the delta-V or speed change data is accurate to at least +/- ten percent (10%). Using these ranges, the travel speed of the Ford F-250 at Time 0 was approximately 48 mph to 52 mph, not including tire size effects. The delta-V at 141 ms would be approximately -15.7 mph to -19.2 mph.

V2 - 2008 Ford Escape

This vehicle was equipped with a V6, 3.0-liter gas engine, and an automatic transmission. It had front and side airbags. The tires on the vehicle were all size 235/70R16.

The rear of this vehicle sustained heavy damage. The left rear door is displaced forward and upward. The left rear fender is distorted and crumpled forward of the rear axle and the left

C-pillar and D-pillar were in close proximity, see **Figure 11**. The bottom of the hatch was distorted forward of the rear axle and the rear window was not present. (**Figure 12**). The rear roof line was displaced upward and forward. The right fender was also distorted and displaced forward. Sections of the right side C and D-pillars were also in close proximity and the top, aft section of the right rear door was displaced downward, see **Figures 13-14**.

Figure 11: Left side of Ford Escape

Figure 12: Left rear corner of Ford Escape

Figure 13: Right rear corner of Ford Escape

Figure 14: Right side of Ford Escape

Witness Testimony

Trenton Rhodes

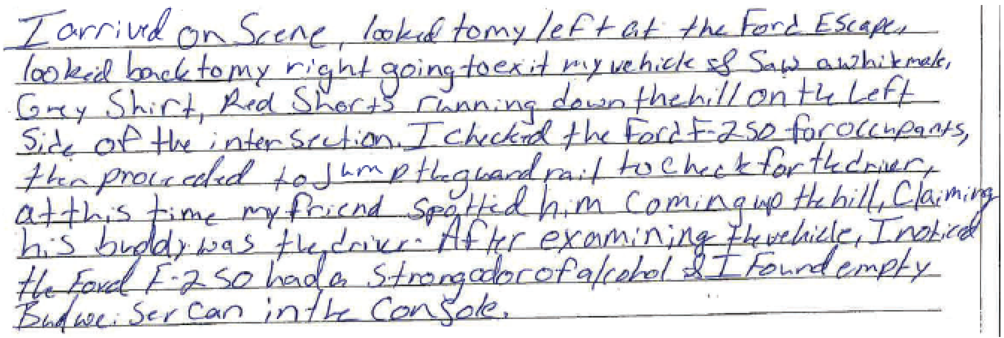

I arrived on Scene, looked to my left at the Ford Escape, looked back to my right going to exit my vehicle & Saw a white male, Grey Shirt, Red Shorts running down the hill on the Left Side of the intersection. I checked the Ford F-250 for occupants, then proceeded to Jump the guard rail to check for the driver, at this time my friend spotted him coming up the hill, Claiming his buddy was the driver. After examining the vehicle, I noticed the Ford F-250 had a Strong odor of alcohol & I Found empty Budweiser can in the Console.

Figure 15: Rhodes statement from police report

Cheri Meaders

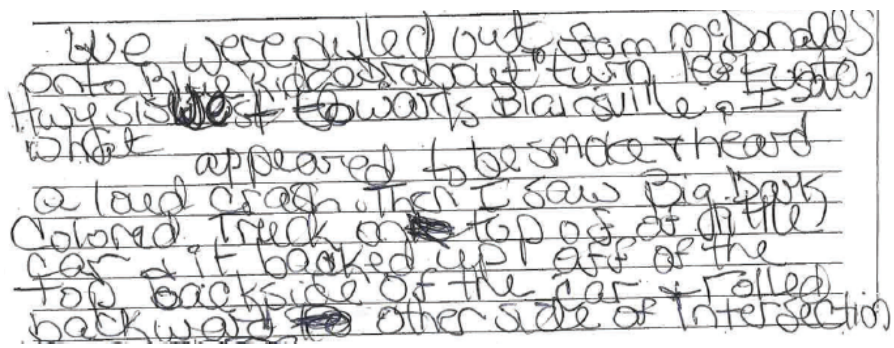

We were pulled out from McDonalds onto Blue Ridge about to turn left to Hwy 515 west towards Blairsville. I saw white appeared to be smoke & heard a loud crash. Then I saw Big Dark Colored Truck on top of a little car & it backed up off of the top backside of the car & rolled backward other side of intersection

Figure 16: Meaders statement from police report

Thomas Barker

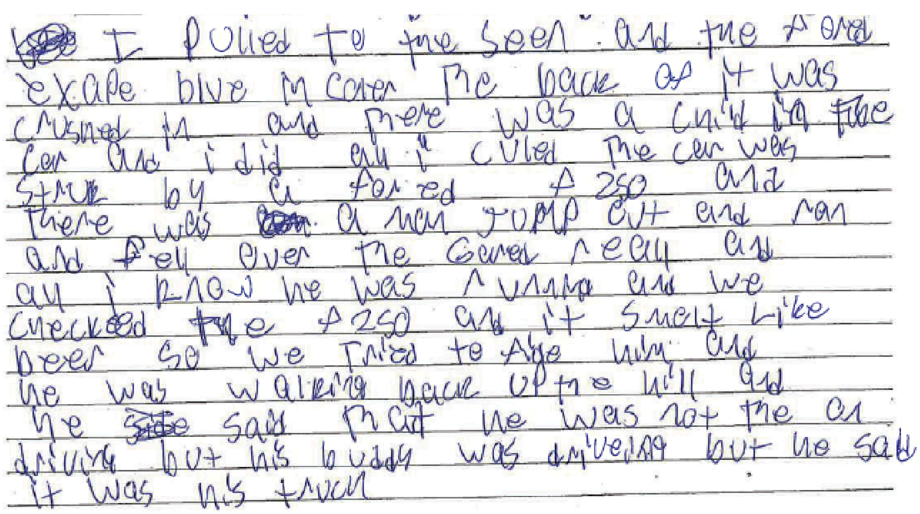

I pulled to the seen and the ford excape blue in color the back of it was crushed in and there was a child in the car and i did call i culled the car was struck by a forred f 250 and there was a man jump out and ran and fell over the guard reall and all i know he was running and we checked the f250 and it smelt like beer so we tried to Ask him and he was walking back up the hill and he said that he was not the driving but his buddy was driveing but he said it was his truck

Figure 17: Barker statement from police report

Connie Nix

We had just pulled out of McDonalds turning left, when we got to the light and the red and the big truck was on top of the little car and the then wiggle it's way off the car and the backed up to avoid the turning lane. I did not see the other truck until all the people got out of the truck with those Light Bar on top
When turned Light was red got to the Light it turned green & that's when I seen the truck wiggle 4 times before going to turning lane

Figure 18: Nix statement from police report

Depositions

Joshua Bryson

Mr. Bryson was deposed on April 12, 2023. He lives in Cedartown, Georgia with his wife and two children. Mr. Bryson has a memory of going to the red light and Santana said someone behind her had very bright lights. He does not remember being stopped at the light. He remembers Cohen sleeping during the trip. He does not remember the collision or anything at the scene. Santana gave birth to Chandler five days later. The car seat was purchased in 2018 at WalMart or Amazon. Mr. Bryson has talked to witness Trenton Rhodes since the accident, he said he wanted to check on them. He believes the driver caused the accident, but because the truck was too high, it caused more damage than if it hit the bumper. He said the shop vac was in the cargo area of the Escape, but does not know where in the cargo area. He also said an umbrella stroller, two camping chairs, and a bag of clothing were in the cargo area of the Escape.

Santana Bryson

Ms. Bryson was deposed on April 12, 2023. She lives in Cedartown, Georgia with her husband and two children. They were at a birthday party and left about 10:30 pm. They swapped drivers at the end of the driveway, so she was driving. Cohen was asleep by the time they got to the end of the driveway. She saw Cohen in the car seat with his eyes shut and his head to the right. She told Josh there was someone flying up behind her with their bright lights on. She was in the left lane when she saw the bright lights. Ms. Bryson does not remember getting to the red light where the collision happened. The last thing she remembered was passing the Taco Bell, she was in the left lane, and noticed the bright lights. She does not remember being stopped at the light before impact. She talked to witness Tommy Nelson. They saw each other at Myrtle Beach and she has not talked to any other witness. She does not remember the positions of the shop vac, camping chairs, or stroller. Ms. Bryson thinks the chairs were on the bottom because they

did not use them often. There was a bag of clothes in the back. She said there was a spider plant in the right rear floor pan and a toy truck on the back seat. The car seat was purchased at Sam's Club. She faults Mr. Elliot for the accident, but also the truck, speed, and phone. She heard Mr. Elliot was on the phone at the time of the accident.

Trooper Andrew Phillips

Trooper Phillips was deposed April 26, 2023. He received an Associate's Degree in General Studies. He is employed by the Georgia Department of Public Safety and is part of the Georgia State Patrol and its SCRT team based out of Calhoun, Georgia. From the report, he said Ms. Kelley (Bryson) was driving a Ford Escape in the left lane and was stopped at a red light. Mr. Elliot was driving a Ford F-250 in the left lane. He says the speed limit for that stretch of roadway is 45 mph. He says he knows it says 55 mph, but it is 45 mph and it is listed 45 mph on the bottom of page 35. He said the roadway and vehicles did not cause the collision. He said Mr. Elliot was driving with a suspended license, was under the influence of alcohol (BAC 0.252), and was Face Timing his fiance. The blood draw for BAC was taken about 2.5 hours after the collision. He concluded Mr. Elliot operated his vehicle in a reckless and unsafe manner while under the influence of alcohol, and his actions were the cause of the death of Cohen Bryson. From the CDR Report, the F-250 was traveling 52 mph at -5 seconds and 50 at 0 seconds. Trooper Phillips did not interview the witnesses, but he used the statements that were given to him. He did not perform a biomechanical assessment or any other assessment to determine if Cohen would have survived if there was less intrusion and does not have an opinion of that topic. He concluded the car seat was installed correctly. He did not perform an analysis regarding the movement of the rear seat from the intrusion.

Rad J. Hunsley

Mr. Hunsley was deposed on August 4, 2023. Mr. Hunsley was acting as a corporate representative for Rough Country and the deposition was regarding the financial condition of Rough Country and lift sales. He is an engineer and Vice President of Research and Design, he is not an accountant. He agreed this case is about a 4.5-inch lift kit sold in Georgia.

Crash Test

On May 15, 2023, a single-moving-vehicle crash test was performed at Exponent in Phoenix, Arizona. The test F-250, VIN: 1FT7W2BTXGED47610, with its factory suspension and recommended tire size, LT275/65R20, was towed into impact rolling straight ahead. The test Escape, VIN: 1FMCU03138KA39182, was stationary and positioned, facing the same direction as the F-250, with its longitudinal centerline 10.9 inches to the right of the F-250 longitudinal centerline. In this orientation, the front of the F-250 impacted the rear of the Escape (**Figure 19**). The speed of the F-250 at impact was 49.9 mph. The weight of the F-250 and Escape was 8,533 pounds and 3,941 pounds, respectively. These weights were determined from the vehicle specifications, the occupants in each vehicle and the cargo that was in the vehicles. The cargo was determined from the post-crash photographs and subsequent inspections. No modifications were made to the suspension or tires of the F-250. The tire sizes matched the Tire Information

decal on the B-pillar. Since the loading of the cargo in the Escape could not be determined, no cargo or ballast was placed in the rear cargo area of the Escape.

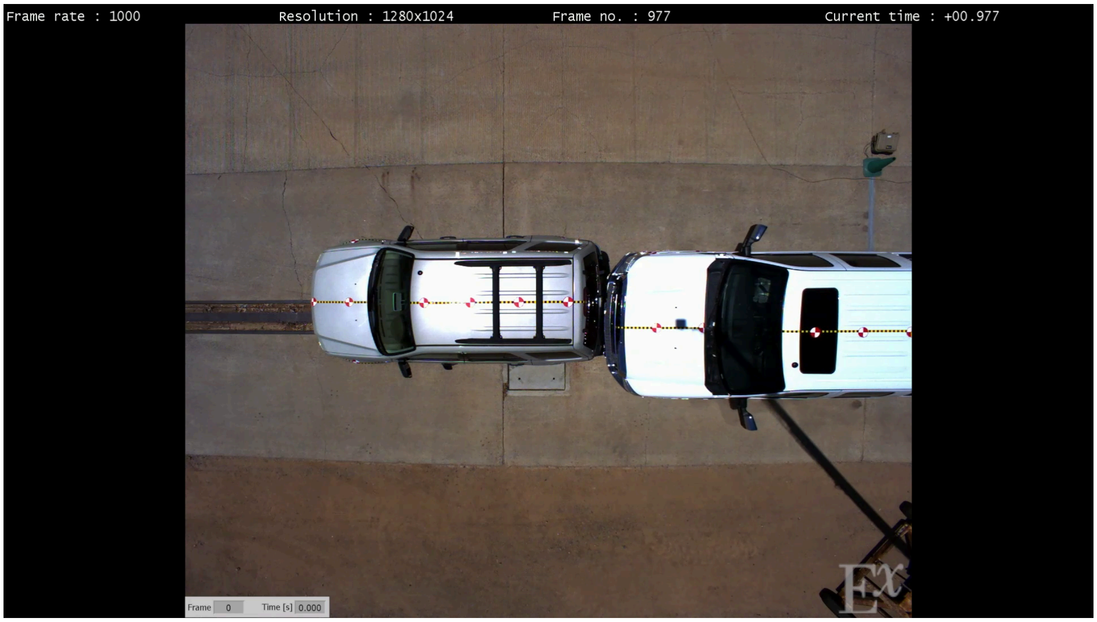


Figure 19: Impact configuration of F-250 and Escape from test video

Each vehicle was equipped with a triaxial accelerometer set at the base of the left and right B-pillar. Seven video cameras and still photographs documented the test, including one video camera inside the Escape. After the test, the vehicles were photographed and scanned using a FARO 3-dimensional scanner. In addition, the F-250 airbag control module was downloaded. Data from the triaxial accelerometers were downloaded and plotted, as well as calculations of velocities and delta-V.

A VIN analysis of the subject and test vehicles showed the F-250s had the same make, vehicle line, series and body type (positions 5 through 7), engine type (position 8), and model year (position 10), (**Figure 20**). The differences were the check digit (position 9), assembly plant (position 12), and production sequence number (positions 13 through 17). The only differences with the subject Escape and test Escape VINs were the check digit (position 9) and production sequence numbers (positions 13 through 17), (**Figure 21**). This VIN analysis shows that the subject vehicles and test vehicles were substantially similar.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Subject	1	F	T	7	W	2	B	T	9	G	E	C	7	9	1	4	0
Test	1	F	T	7	W	2	B	T	X	G	E	D	4	7	6	1	0

Figure 20: VIN of the Subject F-250 and Test F-250

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Subject	1	F	M	C	U	0	3	1	7	8	K	A	7	7	9	5	2
Test	1	F	M	C	U	0	3	1	3	8	K	A	3	9	1	8	2

Figure 21: VIN of the Subject Escape and Test Escape

Other Reports

G. Bryant Buchner

Mr. Buchner produced a report dated October 12, 2023. In this report, he lists his observations from the inspections of the vehicles, site, and the CDR Report of the Ford F-250 starting on Page 3. These observations include the following:

For the 2008 Ford Escape:

- *The Escape's static rear crush damage extended forward to a depth of 3.66 feet.*
- *The Escape's rear occupant seat was pushed visibly forward from impact.*
- *Damage to the rear of the Escape exhibited damage that matched components of the F-250.*
- *The bumper had a 4.5-inch imprint from the (F-250's) SEAS bracket.*
- *There was a gap between the rear passenger seat and the hatch which corresponded to trunk contents such as a shop vac and folding chairs in the vehicle.*
- *The Escape's measured weight was 3,410 pounds.*

The rear seat of the Escape was displaced forward, but the center section of the seat appeared displaced more than the outside portions of the rear seat. The center section is also in the area where the rear seat back was split. Mr. Buchner indicated the Escape's measured weight was 3,410 pounds. There was no indication of what was inside the vehicle at the time it was weighed or the level of fluids in the vehicle. The curb weight from vehicle specifications was between 3,368 pounds and 3,395 pounds.

For the 2016 Ford F-250:

- *F-250 front-end damage was visible on the bumper, grille, and hood.*
- *F-250 crush extended slightly further back on the right side of the vehicle.*
- *Two impact marks were present on the top of the hood of the F-250, about 28 inches apart which corresponded to the Escape's hatch hinges.*
- *The F-250 has two tow hooks on the front bumper, which are 30 inches above the ground.*
- *The F-250 has two SEAS brackets underneath the bumper, about 4.5 inches in width.*
    - *The bottom edges of the brackets are 19 inches from the ground.*
- *The F-250 had an aftermarket Rough Country, "RC", lift kit installed.*
- *There were no RC lift kit warning stickers on any windows of the vehicle.*

- *The F-250 tires' radii were about half an inch larger than stock tires.*
- *The effective total body lift was 6.1 inches.*
- *The vehicle's measured weight was about 8,040 pounds at the time of the inspection.*

The top of the tow hooks were approximately 30 inches above the ground. At Mecanica's inspection of the F-250, the height to the bottom edge of the SEAS brackets were approximately 18 inches from the ground (**Figure 22**). Since the left-front tire was flat at the inspection, an effort was made to "level" the vehicle side-to-side. Mr. Buchner stated the weight of the F-250 was 8,040 pounds at the time of the inspection. Again there was no indication of what was in the vehicle or cargo area of the vehicle when it was weighed. For example an empty tool box that was in the truck at the time of the accident weighed approximately 165 pounds. Also, the level of the fluids in the vehicle was not indicated in the report. For example, the truck with a fuel tank half full would be lighter than one with a full tank by approximately 140 pounds (17.5 gallons x 8 pounds per gallon). The curb weight from vehicle specifications was between 7,462 pounds and 7,850 pounds.

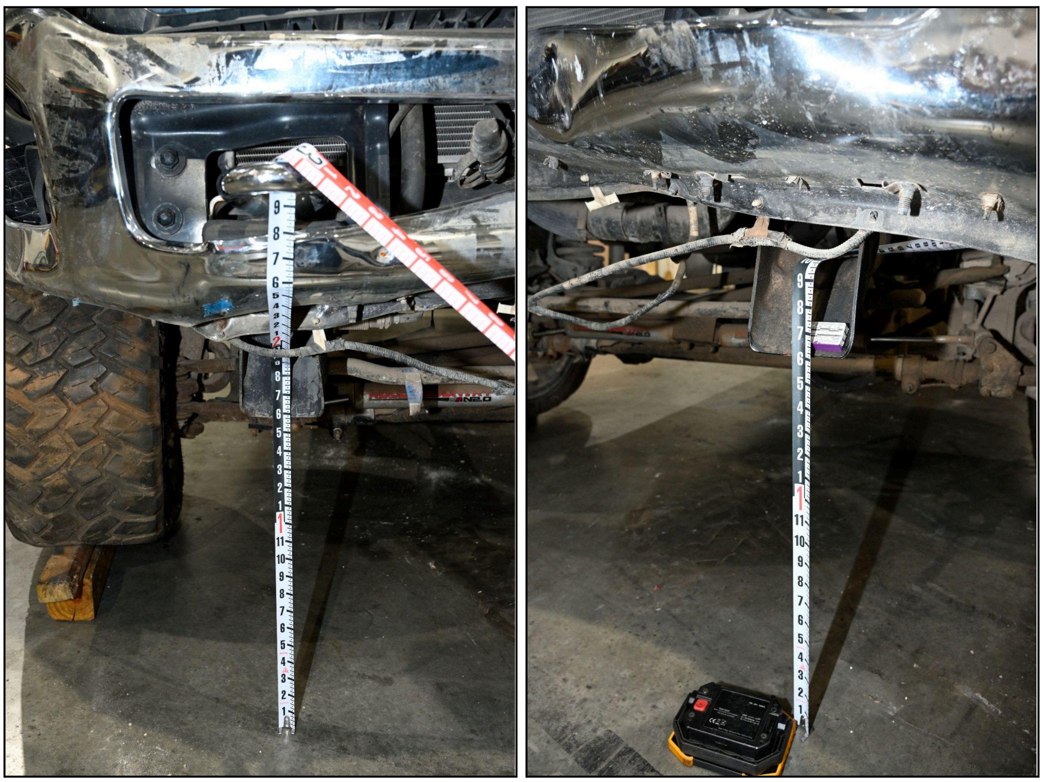


Figure 22: Height of the left and right SEAS brackets

2016 Ford F250 EDR:

- The data was downloaded 20 ignition cycles after the event.
- The recorded speed of the F-250 was about 52 mph five seconds prior to airbag deployment.
- The recorded speed of the F-250 was 50 mph immediately prior to airbag deployment.
- The impact delta-V was 17.92 mph longitudinal and 0.14 mph lateral.

- The principal direction of force was 6 o'clock.
- The EDR under reported speed by 1 mph due to the oversized tires.

The CDR report provided in the SCRT report indicated the ignition cycles at the time of the crash and download were 6,697 and 6,698, respectively. It appears Mr. Buchner imaged (downloaded) the information separately on April 3, 2020. He states the speed of the F-250 five seconds and just prior to airbag deployment. The frontal airbags of the F-250 did not deploy in this crash (**Figure 23**) and therefore the speeds cannot be referenced from the time of airbag deployment. According to 49 CFR 563, time 0 in the CDR Report indicates when algorithm enable occurs, not airbag deployment. Airbag deployment, when it occurs, happens after algorithm enable.

The Deployment data from the CDR report indicated the maximum longitudinal delta-V as -18.21 mph and the maximum lateral delta-V as -0.76 mph. Mr. Buchner reported the last longitudinal and lateral delta-Vs in the respective tables. Although these were the last values in the respective tables, they are not the values at the end of the event. 49 CFR 563 states, the end of event time is the moment at which the cumulative delta-V within a 20 ms interval becomes 0.5 mph or less. For this crash, the end of the event was approximately 141 ms after Time 0. At 141 ms, the longitudinal delta-V was -17.48 mph and the lateral delta-V was -0.40 mph. Based on these delta-Vs, the Principle Direction of Force (PDOF) was from approximately 12 o'clock.

Figure 23: Front occupant area of F-250 showing the airbags did not deploy in this crash

Based on Quest's site inspection and the accident scene photographs:

- The Escape's spare tire rim left a clear impact mark on the asphalt clearly defining the area of collision.
- The impact was in the left thru lane near the stop bar.
- The Escape was propelled approximately150 ft from impact to rest.

There was damage to the inner wheel flange of the spare tire consistent with the damage mentioned by Mr. Buchner (**Figure 24**).

Figure 24: Damage to the spare tire wheel of the Escape

On page 6 of the report, Mr. Buchner used a 2015 Ford F-250 Super Duty, Crew Cab, four-wheel drive pickup with LT275/70R18 tires as an exemplar vehicle. Although the VIN for Mr. Buchner's exemplar F-250 was not given, the Tire and Loading Information decal on the left B-pillar of the subject vehicle (**Figure 25**) shows the recommended tire size for the subject F-250 was LT275/65R20. The difference between the diameter of the tire sizes of Mr. Buchner's exemplar F-250 and the recommended tire size of the subject F-250 is approximately one inch. This would decrease the height of Mr. Buchner's F-250 by approximately one half inch over the 2016 Ford F-250 involved in this crash.

Figure 25: Tire and Loading Information from the Subject F-250

On Page 9 of his report, Mr. Buchner stated the ACM recorded 251 ms (0.251 seconds of post-crash delta-V data. In reality, the ACM recorded 250 ms of data starting at 1 ms and ending

at 251 ms. Although this could be overlooked, it shows inaccuracies in the report. He also repeats the ACM recorded a longitudinal delta-V of -17.92 mph and a lateral delta-V of -0.14 mph. Although he was correct that the ACM recorded these numbers, use of these numbers in calculations would lead to different results than if the correct numbers at the end of the event were utilized. At the bottom of page 9, Mr. Buchner talks about momentum calculations since the weights of both vehicles were measured. Although correct in stating this method may be used for speed calculations, using just the measured weights of the vehicles would lead to inaccurate results. The weights of the occupants and cargo must be used to accurately calculate vehicle speeds.

Mr. Buchner states on page 10 of his report that the Escape was stopped at impact. Although this is likely the case, both Mr. Bryson and Mrs. Bryson could not remember in their depositions stopping at the red light. Furthermore, he states there was enough information to use a crush analysis to calculate the amount of crush that would have occurred if the F-250 was lowered and contacted more of the structural components of the Escape. This is not the case for this crash. When one performs a crush analysis, there are stiffness coefficients used to determine the energy dissipated from the homogeneous vehicle deformation. Based on crash testing of exemplar vehicles, the stiffness coefficients can be determined. When override occurs, the closing speed can be estimated by using crush profiles at different levels. In this approach, damage energy can be estimated by using 100 percent of the energy at the bumper level and 50 percent of the energy above the bumper. The problem with predicting the amount of deformation in a crash with different parameters is whether the dynamics of the collision will result in override or not. Mr. Buchner then makes the statement that his analysis showed that if the F-250 was not raised, the Ford Escape would have had significantly less crush than occurred in the subject accident. Based on the crash test we conducted, Mr. Buchner was incorrect about the amount of deformation to the Escape if the F-250 was not raised.

On page 10, Mr. Buchner talks about simulating the collision using HVE and the SIMON model. To make a full evaluation of the simulation, the HVE file, vehicle geometries, and any site images and geometries will be required. When using a simulation model, one must understand the limitations of the model. The SIMON model utilizes the DyMesh (Dynamic Mechanical Shell) algorithm for analyzing forces and deformation. This algorithm uses nodes and surfaces for these calculations and in simple terms, places a shell around the outside of the vehicle and uses individual stiffness coefficients for the front, rear, left, right, top, and bottom. The program does not allow the user to specify different stiffness coefficients for the rear bumper and trunk or the front bumper and the hood. Additionally, since the program uses a shell around the vehicle there is no means for the program to account for where the structural members are located on the vehicle and simulate the override in this case. Mr. Buchner's use of HVE/SIMON/DyMesh to predict crush on the Escape in this case is improper and beyond the capabilities of the software.

In the Analysis and Conclusions section of his report, Mr. Buchner states that had a stock F-250 impacted the Escape at 51 mph, the crush on the rear of the Escape would have been dramatically reduced. This was not the case in the crash test where a stock F-250 overroad the Escape's rear bumper and intruded into the rear cargo area. Mr. Buchner also stated that had the F-250 not been lifted, a more flush contact between the bumpers would not have caused the

override. Mr. Buchner was incorrect in this statement and may have been the result of using incorrect exemplar vehicles.

Mr. Buchner uses 17.93 mph delta-V for the F-250. Since he did not use the correct value for the delta-V of the F-250, his calculated values for the Escape's delta-V (40 mph) and the Escape's maximum acceleration (23.6g) are higher than the actual values. Mr. Buchner's simulation results indicate that if a stock F-250 impacted the Escape, the impact would have resulted in a near 45g acceleration to the Escape. This is likely due to the limitations of the simulation and the inputs placed into the program. Finally, Mr. Buchner states the calculations and simulations of the accident with the F-250 at factory height produced collisions that reduced the Escape's crush and resulted in damage which would not have penetrated to the rear seat such that the rear occupant compartment would not have been compromised. The crash test using a F-250 at "factory height" into an Escape produced substantially similar deformation to the Escape and he is incorrect in his statement.

<u>Christopher Roche</u>

Mr. Roche's report addresses vehicle crashworthiness and vehicle compatibility issues. This is outside the area of this report and will not be addressed herein, except where the report discusses the reconstruction of the crash. On page 7 of the report, Mr. Roche states the subject F-250's trim level was a King Ranch. The trim level of the subject F-250 was in fact a Lariat (**Figure 26**).

Figure 26: Trim level of the subject F-250

On page 24, he states that the delta-V recorded by the F-250 was about 18 mph, and the driver airbag did not deploy. This was despite known deployment thresholds indicating that at 18 mph, the probability of deployment was 80 percent. The paper he used as a reference only used model years 1994 to 2011. The subject F-250 was a 2016 model year. The paper also states that over time the deployment thresholds have increased 2-3 mph at the 25 percent level and 3-4 mph at the 75 percent level. Furthermore, in reviewing the NASS data used for the SAE

paper, there were a total of 43 Ford F-series vehicles in the database involved in reported accidents. Of those 43 trucks, only 19 were F-250s, F-350s, or F-450 models. Of those 19 pickup trucks, only one had the EDR imaged (downloaded). The one truck was an F-350 and had a longitudinal delta-V of -3.37 mph and a lateral delta-V of 0.0 mph. The only other Ford pickup truck in the database that was downloaded was a F-150. Since the larger Ford pickup trucks were not represented in the data used for the SAE paper, the relationship between delta-V and airbag deployment is not statistically significant for these vehicles.

On page 25 of his report, Mr. Roche states that according to the Event Data Recorder (EDR) download from Elliott's truck, he was still on the accelerator pedal and not on the brake all the way up to 0.5 sec(onds) prior to airbag deployment. However, time 0 is not at airbag deployment, but is at algorithm enable. Although these are relatively close together, time 0 at airbag deployment is not accurate, especially since the airbags in the subject F-250 did not deploy.

On page 26 of his report, Mr. Roche opines that if the crash had occurred with a regular, non-lifted F-250 with sufficient compatibility, as shown in image 23, then the risk of intrusion into the occupant compartment survival space would have been reduced. **Figure 27** shows a comparison of image 23 from Mr. Roche's report and a similar view from the crash test setup photographs. No data was presented for the exemplar Escape or exemplar F-250 Mr. Roche used in his vehicle alignment, except that the bumper heights were used from FMVSS 301 test data. In all the NHTSA crash testing for the 2016 Ford F-250, the tire size was LT275/65R18. The recommended tire size on the subject F-250 was LT275/65R20. This indicates that Mr. Roche's analysis of the vehicle alignment was not accurate and his exemplar F-250 bumper height was incorrect by up to one inch.

Figure 27: Comparison of Mr. Roche's exemplar bumper heights and crash test bumper heights.

<u>*Paul R. Lewis, Jr.*</u>

Mr. Lewis' report addressed the injuries to Mr. Cohen Bryson. This area is outside the scope of this report and will not be addressed herein, except where the report discusses the reconstruction of the crash. Mr. Lewis utilizes the reconstruction information from the Quest Engineering (Bryant Buchner) report. Review of Mr. Buchner's report was performed in a previous section of this report. The inaccuracies noted in Mr. Buchner's report would therefore be included in Mr. Lewis' report. The following observations were from Section VI. Analysis, Opinions, and Support.

1. *Cohen's fatal injuries would have been prevented had the Ford truck not been lifted to a height above the factory recommendation, which would lessen the amount of structural damage and intrusion, preserving his occupant survival space.*

Mr. Lewis provides no analysis as to whether a "factory" Ford truck would have lessened the amount of deformation to the rear of the Escape. He has no basis to make a comparison of the deformation to the Escape between a "lifted" and "factory" truck. He relied on Mr. Buchner's analysis and he did not mention a separate analysis regarding the deformation comparison between lifted and factory trucks. In fact, a crash test with true exemplar vehicles showed the deformation would be substantially similar.

1.10 *….The car seat used in the study is the same make and model as Cohen's car seat and the exemplar vehicle's driver's seat was adjusted to the position, I documented it to be at my vehicle inspection*.

Mr. Lewis did not provide details of the surrogate study he performed. He indicated he used the same make and model of the subject car seat, but did not indicate if the exemplar car seat was manufactured at approximately the same time as the subject car seat. If it was not, what were the differences between the two car seats? In addition, he does not provide details regarding the exemplar vehicle used in the surrogate study. The year, make, model and VIN of the exemplar vehicle should have been provided to substantiate whether the vehicle used was actually an exemplar vehicle.

1.11 *….The generally accepted principle is that dynamically, as the crash and subsequent movements of vehicle structures is occurring, the movement of the structures could be as much as 20% greater than demonstrated in the static condition.*

Mr. Lewis does not provide any reference for the difference between the static and dynamic deformation of vehicle structures. He states that it could be as much as 20 percent greater than the static crush, but it could be less than 20 percent. Mr. Lewis also does not address if there was any loading to the webbing of the car seat, latches, or surrounding structures.

1.16 *My surrogate study with an infant approximately the same size as Cohen….*

Mr. Lewis does not provide data on the infant he used in his surrogate study, only that they were approximately the same size. Details such as height, seated height and weight should have

been provided. Without such details, there is no approach to validate the surrogate study. In addition, in the photographs below 1.16 and 1.17, the tape measures are referenced from different locations on the head rest. Since the rear of the headrest slants forward, the photograph under 1.16 would provide a longer distance than the position of the tape measure in the photograph after 1.17.

1.21 Had the Ford truck not been lifted, it would have engaged the rear structures of the Escape such as the bumper that attenuate and distribute the crash forces.

Mr. Lewis provided no analysis as to whether a “factory” or non-lifted Ford truck would have lessened the amount of deformation to the rear of the Escape. He has no basis to make a comparison of the deformation to the Escape between a “lifted” and “factory” truck. He relied on Mr. Buchner’s analysis and he did not mention a separate analysis regarding the deformation comparison lifted and factory trucks. The crash test performed with true exemplar vehicles showed the deformation would be substantially similar.

1.24 Had Cohen’s survival space been preserved via the Ford truck being a stock height and not one above the factory recommendation, he would have been expected to survive this incident with non-life threatening and non-permanently disabling injuries.

Mr. Lewis provided no analysis as to whether a “factory” or non-lifted Ford truck would have lessened the amount of deformation to the rear of the Escape. He has no basis to make a comparison of the deformation to the Escape between a “lifted” and “factory” truck. He relied on Mr. Buchner’s analysis and he did not mention a separate analysis regarding the deformation comparison between impacts with a lifted pickup and stock pickup truck. The crash test performed with true exemplar vehicles showed the deformation would be substantially similar.

Summary of Analysis

Subject Ford F-250 CDR Report

Taking into account the tire size on the subject F-250 at the time of the crash, the indicated speed of 50 mph in the CDR report was actually 51 mph. Since the crash pulse data (delta-V) was not dependent on wheel or transmission speed, no correction was necessary. From the F-250’s CDR report, at the end of the event, 141 ms, the longitudinal delta-V was -17.48 mph and the lateral delta-V was -0.40 mph. This would produce a resultant delta-V of 17.5 mph and a PDOF from approximately 12 o’clock. Using the vehicle weights and the F-250’s delta-V, the calculated delta-V for the Escape was approximately 38.1 mph. Applying the +/- 10% range for the ACM reported delta-V data from the F-250, the calculated delta-V for the Escape would be approximately 34 mph to 42 mph. Considering the damage pattern, vehicle motion, and general alignment, the PDOF for the Ford Escape would be from approximately 6 o’clock.

Crash Test

The impact speed of the F-250 was determined by the subject F-250's CDR report, and the analysis performed on the F-250's CDR data. The alignment of the vehicles was determined by the alignment of the subject vehicle scans at maximum mutual crush and key features (such as the F-250's front tow hooks) interactions observed at the inspections (**Figure 28**). The longitudinal centerlines of both vehicles were approximately parallel and the Escape was offset to the right approximately 11 inches. It was determined to use the standard or original tires, wheels, and suspension for both vehicles for the crash test to observe the differences and similarities between the crash test and subject crash.

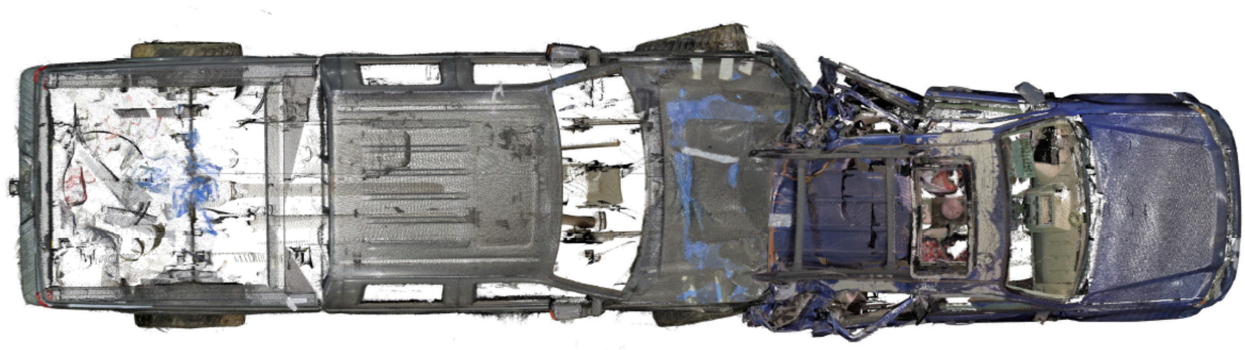


Figure 28: Determination of impact orientation using scan data.

From the data produced by the crash test, the accelerations and delta-Vs were comparable to the calculations from the F-250's CDR report. Based on the CDR Report for the crash test F-250, at 124 ms, the F-250's longitudinal delta-V was approximately -17.45 mph and the lateral delta-V was 0.44 mph. The resultant calculated delta-V was approximately 17.46 mph with a PDOF from approximately 12 o'clock. Based on the test F-250's CDR report and test vehicle weights, the Escape's cumulative delta-V at 124 ms was approximately 37.8 mph. The data indicated the crash test and subject collision were similar in accelerations and delta-V. Comparing the resultant delta-Vs for the F-250 from the collision and the crash test, the resultant delta-V from the crash test was 17.46 mph and the collision F-250 was 17.48 mph (**Figure 29**). The differences between the two delta-Vs in Figure 15 between approximately 50 ms and 130 ms, was likely due to the cargo in the back of the subject Escape along with slight differences in the interaction between specific structures involved in the two impacts.

Table 1 contains a comparison of vehicle impact speeds and delta-Vs for the crash and the test that was conducted.

Table 1 - Crash Speeds and Delta-Vs vs Test Speeds and Delta-Vs				
	Crash Impact Speed (mph)	Test Impact Speed (mph)	Crash Speed Change (mph)	Test Speed Change (mph)
Ford F-250	51	49.9	17.5	17.5
Ford Escape	stopped	stopped	38.1	37.8

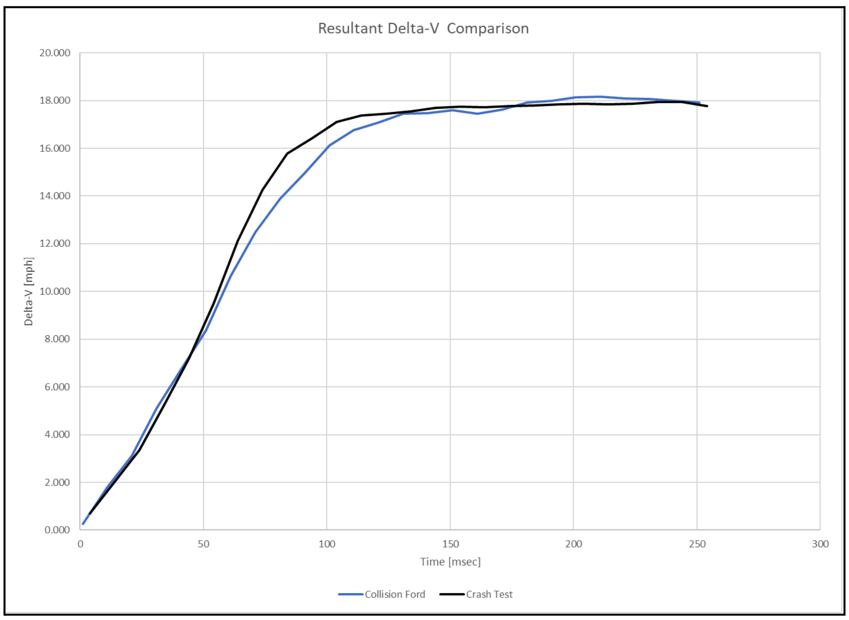


Figure 29: Resultant delta-V comparison between crash test and collision F-250.

The front bumper of the F-250 and the rear bumper of the Escape were approximately aligned at impact (**Figure 30**). During the impact phase of the collision, the front bumper of the F-250 went over (overrode) the rear bumper of the Escape (**Figure 31**). This allowed intrusion of the front of the F-250 into the cargo area and displacement of the rear seat of the Escape. It also increased the load on the rear tires of the Escape, which deflated the left rear tire, similar to the subject collision.

Figure 30: Crash test impact showing relative bumper heights.

Figure 31: Crash test during impact. F-250 bumper overrode Escape.

The damage to the F-250's front bumper was slightly different in the crash test when compared to the subject F-250 (**Figure 32** through **34**). This was expected since the crash test F-250 was equipped with the factory suspension and the recommended tire size. The location of the

deformation to the center of the front bumper was substantially similar. Both F-250s had similar deformation to the hood, grille and deformation to the ends of the front bumper.

Figure 32: Front of the subject F-250 (left) and test F-250 (right)

Figure 33: Left-front view of the subject F-250 (left) and test F-250 (right)

Figure 34: Right-front view of the subject F-250 (left) and test F-250 (right)

The damage to the test Escape was slightly different than the subject Escape. This was expected due to the differences in the subject and test F-250 equipment (**Figures 35 through 37**). There were also significant similarities between the subject and test Escapes. The C-pillars and D-pillars were both displaced forward, the top of the rear lift gate was rotated downward, the crease in the rear tailgate was below the right rear-window hinge.

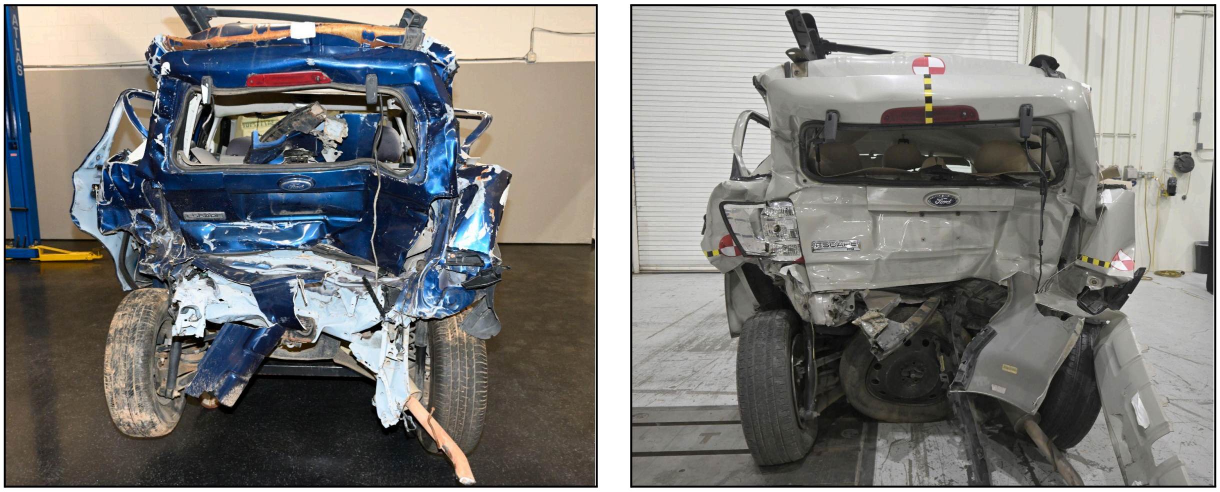


Figure 35: Rear view of the subject Escape (left) and test Escape (right)

Figure 36: Right-rear view of the subject Escape (left) and test Escape (right)


Figure 37: Right-rear view of the subject Escape (left) and test Escape (right)

Both rear seats were displaced and deformed (**Figure 38**). The difference in the seat deformation in both Escapes was probably due to the lack of cargo in the rear cargo area of the test Escape. The test Escape would have sustained more seat deformation had exemplar cargo been placed in the rear cargo area since the rear hatch of the test vehicle had to be displaced through the entire rear cargo area to contact the rear seat back. Had exemplar cargo been identified and placed in the cargo area, the cargo would have been sandwiched between the rear seat back and the rear hatch and subsequently applied a force to the back of the rear seat as it was displaced forward.

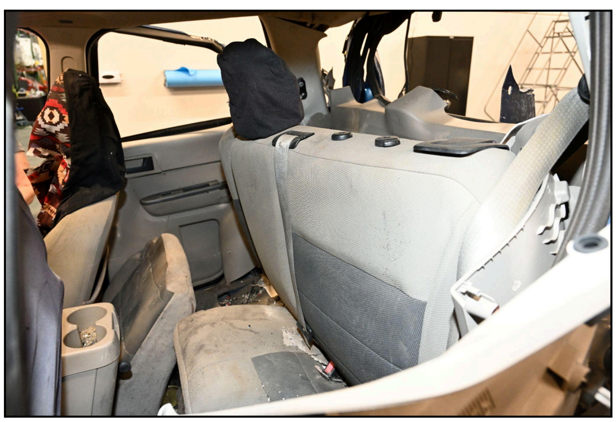
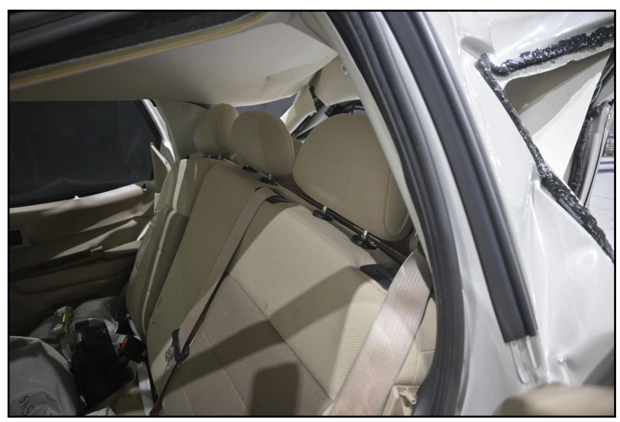



Figure 38: Seat back deformation of the subject Escape (left) and test Escape (right)

Figure 39 shows the alignment comparison of the subject vehicles and that achieved for the test vehicles at maximum static crush. Based on the analyses and crash test performed, the deformation and accelerations of the Escape would have been substantially similar whether the F-250 was lifted or was equipped with a stock suspension. Vehicle outlines were then placed over the vehicle point clouds and the point clouds were then removed (**Figure 40**). The dimension was then measured from the front bumper of the F-250 to the front bumper of the Escape. This dimension was 10.6 feet and 9.9 feet for the subject vehicles and the test vehicles, respectively. This means the crash test had more intrusion than the subject vehicle from the crash.

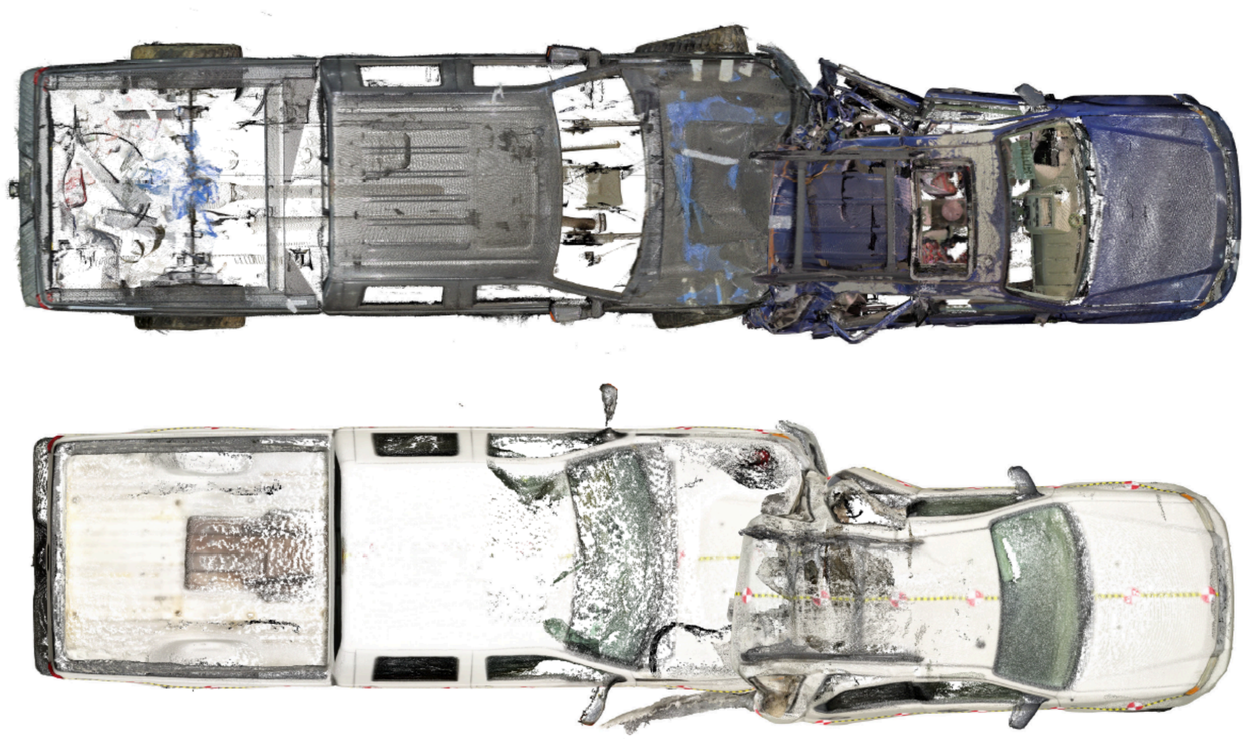


Figure 39: Alignment comparison of subject vehicles (top) and test vehicles (bottom) at maximum mutual crush.

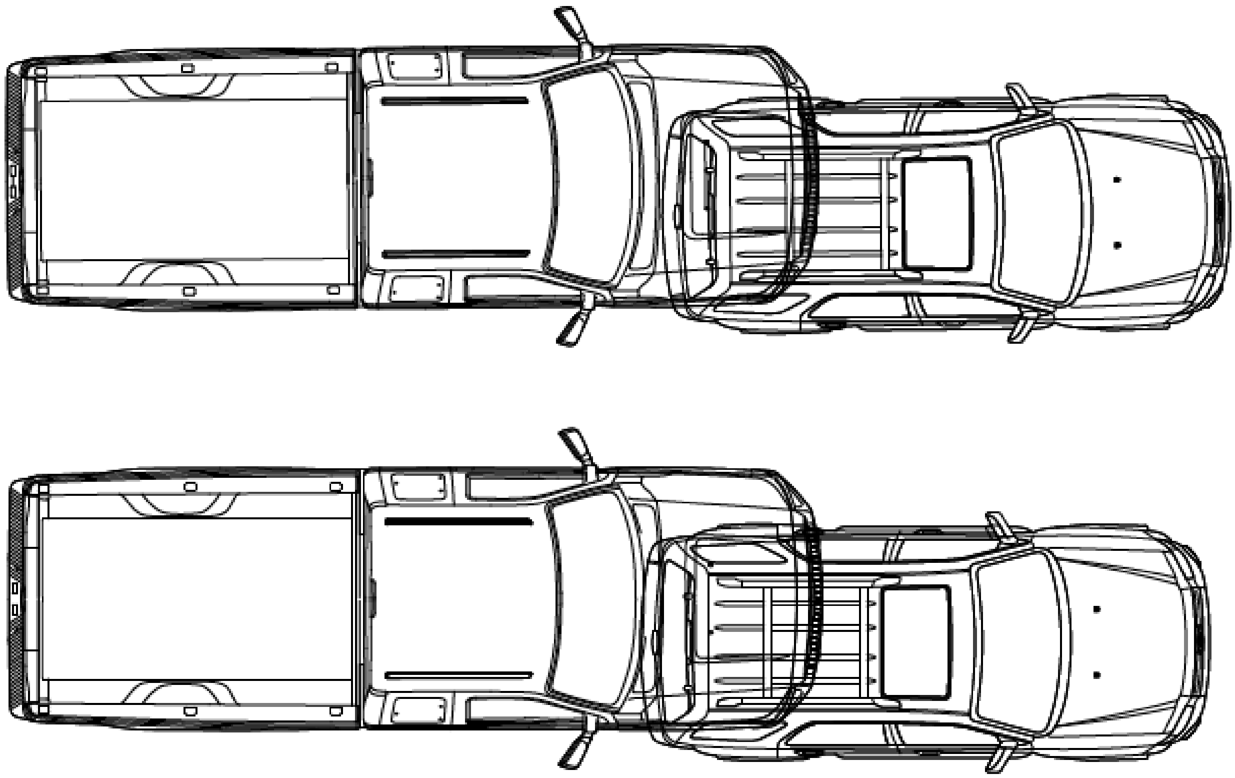


Figure 40: Alignment comparison with vehicle outlines of subject vehicles (top) and test vehicles (bottom) at maximum mutual crush.

Exhibits Utilized in Trial

If called up to offer testimony in trial, some or all of the following exhibits may be utilized:

- Georgia State Patrol Specialized Collision Reconstruction Team Report dated March 15, 2020.
- Georgia State Patrol Specialized Collision Reconstruction Team scene, site, F-250, and Escape photographs.
- Georgia State Patrol Specialized Collision Reconstruction Team Report drone photographs.
- Mecanica inspection photographs, videos, and scanned images from the site, F-250, Escape, and crash test.
- FARO scans of an exemplar F-250 and an exemplar Escape
- Exponent Crash Test Report (TEC2210759), photographs, scans, data, and videos dated May 15, 2023.
- Photographs, scans, calculations, analyses, and graphs used to determine the parameters of the crash test performed on May 15, 2023.
- CDR Reports for both the subject F-250 and the test F-250.
- 3-dimensional point cloud data for the vehicles involved in the subject crash.

- 3-dimensional point cloud data for the vehicles involved in the test.
- Any documents listed or discussed in this report.

Compensation

Work was performed by Wesley Grimes and other engineers at Mecanica Scientific Services. Billing rate for Mr. Grimes was $365 per hour when initial work began on this case, his current rate is $390 per hour. Billing rate for additional engineers is at $225-$355 per hour.

Conclusions

After conducting the preliminary analysis discussed in this report, we have come to the following conclusions, to a reasonable degree of scientific certainty.

1. The collision between the F-250 and Escape occurred on Georgia State Route 2, at the intersection with Georgia State Route 5. The speed limit on Georgia State Route 2 was 45 mph.

2. A lift kit was installed on the subject F-250 as evidenced by the components observed at the inspection.

3. The Escape was stopped at the intersection or moving very slowly when the front of the F-250 impacted the rear of the Escape.

4. The F-250 was traveling approximately 49 to 53 mph when the collision occurred, based on the F-250's CDR Report, calculations performed, and the data from the crash test performed.

5. The speed change or delta-V experienced by the Ford F250 during this crash was approximately -15.7 mph to -19.2 mph, with a PDOF of approximately 12 o'clock.

6. The delta-V experienced by the Ford Escape during this crash was approximately 34 mph to 42 mph, with a PDOF of approximately 6 o'clock.

7. Based on photographs at the crash scene, cargo was present in the rear area of the Escape. The amount and position of the cargo prior to the collision could not be determined.

8. The F-250 and Escape utilized in the crash test were substantially similar to the subject vehicles based on the analyses of the VINs, with the exception of the suspension and tires of the F-250s. The test F-250 used the factory suspension and recommended tire size.

9. The crash test using an exemplar Escape and exemplar F-250 showed substantially similar deformation, accelerations, delta-Vs, and Escape rear seat deformation between the subject and test vehicles. The suspension of the test F-250 was not modified and the tires were the same size as recommended on the tire decal located on the left B-pillar of both the test and subject F-250.

10. Differences in the slope of the crash and test delta-Vs can likely be attributed to the lack of cargo in the rear area of the Escape and interaction between the components on the vehicles. The cargo was accounted for in the total weight and weight distribution of the test Escape, but cargo was not placed in the rear area since the amount and position of the cargo prior to the collision could not be determined.

11. Based on the analyses and crash test performed, the deformation and accelerations of the Escape would have been substantially similar whether the F-250 was lifted or was equipped with a stock suspension.

We have completed the preliminary analysis of this incident as documented herein and have developed the conclusions outlined. This analysis is based on the items listed herein and if additional information becomes available we will need to review the information and determine how the analysis and these opinions are affected. If you have any questions concerning this report or the analysis, please don't hesitate to contact me.

Respectfully submitted,

MECANICA SCIENTIFIC SERVICES CORP

Wesley D. Grimes, P. E.
Director of Forensic Services

Registered Professional Engineer (Mechanical)
CERTIFICATE NO.
26907
WESLEY D. GRIMES
DATE SIGNED 3/28/24
ARIZONA U.S.A.
Expires 03-31-2026

Appendix A:

Subject 2016 Ford F-250 CDR Report

IMPORTANT NOTICE: Robert Bosch LLC and the manufacturers whose vehicles are accessible using the CDR System urge end users to use the latest production release of the Crash Data Retrieval system software when viewing, printing or exporting any retrieved data from within the CDR program. Using the latest version of the CDR software is the best way to ensure that retrieved data has been translated using the most current information provided by the manufacturers of the vehicles supported by this product.

CDR File Information

User Entered VIN	1FT7W2BT9GEC79140
User	Cpl. J. Allison #591
Case Number	SCRTB-017-20
EDR Data Imaging Date	03/17/2020
Crash Date	03/15/2020
Filename	1FT7W2BT9GEC79140_ACM.CDRX
Saved on	Tuesday, March 17 2020 at 10:41:45
Imaged with CDR version	Crash Data Retrieval Tool 19.3
Imaged with Software Licensed to (Company Name)	Georgia State Patrol
Reported with CDR version	Crash Data Retrieval Tool 19.3
Reported with Software Licensed to (Company Name)	Georgia State Patrol
EDR Device Type	Airbag Control Module
ACM Adapter Detected During Download	No
Event(s) recovered	unlocked event

Comments

DATA IMAGED THROUGH DLC. RECOMMENDED TIRE SIZE LT275/65R20E. TIRE SIZE ON VEHICLE LT325/50R22

The retrieval of this data has been authorized by the vehicle's owner, or other legal authority such as a court order or search warrant, as indicated by the CDR tool user on Tuesday, March 17 2020 at 10:41:45.

Data Limitations

Restraints Control Module Recorded Crash Events:
Deployment Events cannot be overwritten or cleared from the Restraints Control Module (RCM). Once the RCM has deployed any airbag device, the RCM must be replaced. The data from events which did not qualify as deployable events can be overwritten by subsequent events. The RCM can store up to two deployment events.

Airbag Module Data Limitations:

- Restraints Control Module Recorded Vehicle Forward Velocity Change reflects the change in forward velocity that the sensing system experienced from the point of algorithm wake up. It is not the speed the vehicle was traveling before the event. Note that the vehicle speed is recorded separately five seconds prior to algorithm wake up. This data should be examined in conjunction with other available physical evidence from the vehicle and scene when assessing occupant or vehicle forward velocity change.
- Event Recording Complete will indicate if data from the recorded event has been fully written to the RCM memory or if it has been interrupted and not fully written.
- If power to the Airbag Module is lost during a crash event, all or part of the crash record may not be recorded.
- For 2011 Ford Mustangs, the Steering Wheel Angle parameter indicates the change in steering wheel angle from the previously recorded sample value and does not represent the actual steering wheel position.

Airbag Module Data Sources:

- Event recorded data are collected either INTERNALLY or EXTERNALLY to the RCM.

  - INTERNAL DATA is measured, calculated, and stored internally, sensors external to the RCM include the following:
  > The Driver and Passenger Belt Switch Circuits are wired directly to the RCM.
  > The Driver's Seat Track Position Switch Circuit is wired directly to the RCM.
  > The Side Impact Sensors (if equipped) are located on the side of vehicle and are wired directly to the RCM.
  > The Occupant Classification Sensor is located in the front passenger seat and transmits data directly to the RCM on high-speed CAN bus.
  > Front Impact Sensors (right and left) are located at the front of vehicle and are wire directly to the RCM.

  - EXTERNAL DATA recorded by the RCM are data collected from the vehicle communication network from various sources such as Powertrain Control Module, Brake Module, etc.

System Status at Time of Retrieval

VIN as programmed into RCM at factory	1FT7W2BT9GEC79140
Current VIN from PCM	1FT7W2BT9GEC79140
Ignition cycle, download (first record)	6,698
Ignition cycle, download (second record)	N/A
Restraints Control Module Part Number	DC3T-14B321-DC
Restraints Control Module Serial Number	9016157400000000
Restraints Control Module Software Part Number (Version)	CT43-14C028-AB
Left/Center Frontal Restraints Sensor Serial Number	1C787B70
Left Side Restraint Sensor 1 Serial Number	B9472710
Left Side Restraint Sensor 2 Serial Number	1C7DEB49
Right Frontal Restraints Sensor Serial Number	00000000
Right Side Restraint Sensor 1 Serial Number	E2272710
Right Side Restraints Sensor 2 Serial Number	1C782D16

System Status at Event (First Record)

Recording Status	Unlocked Record
Complete file recorded (yes,no)	Yes
Multi-event, number of events (1,2)	1
Time from event 1 to 2 (msec)	N/A
Lifetime Operating Timer at event time zero (seconds)	10,418,515
Key-on Timer at event time zero (seconds)	13,960
Vehicle voltage at time zero (Volts)	13.932
Energy Reserve Mode entered during event (Y/N)	No

BOSCH CDR CRASH DATA RETRIEVAL

Faults Present at Start of Event (First Record)

U3000-49

Deployment Data (First Record)

Maximum delta-V, longitudinal (MPH [km/h])	-18.21 [-29.31]
Time, maximum delta-V longitudinal (msec)	206
Maximum delta-V, lateral (MPH [km/h])	-0.76 [-1.23]
Time, maximum delta-V lateral (msec)	76
Longitudinal Delta-V Time Zero Offset	1.0 ms
Lateral Delta-V Time Zero Offset	1.0 ms
Roll Angle Time Zero Offset	81.0 ms

Pre-Crash Data -1 sec (First Record)

Ignition cycle, crash	6,697
Frontal air bag warning lamp, on/off	Off
Frontal air bag suppression switch status, front passenger	Not Active
Safety belt status, driver	Driver Not Buckled
Brake Telltale	Off
ABS Telltale	Off
Powertrain Wrench Telltale	Off
Speed Control Telltale	Off
MIL Telltale	Off

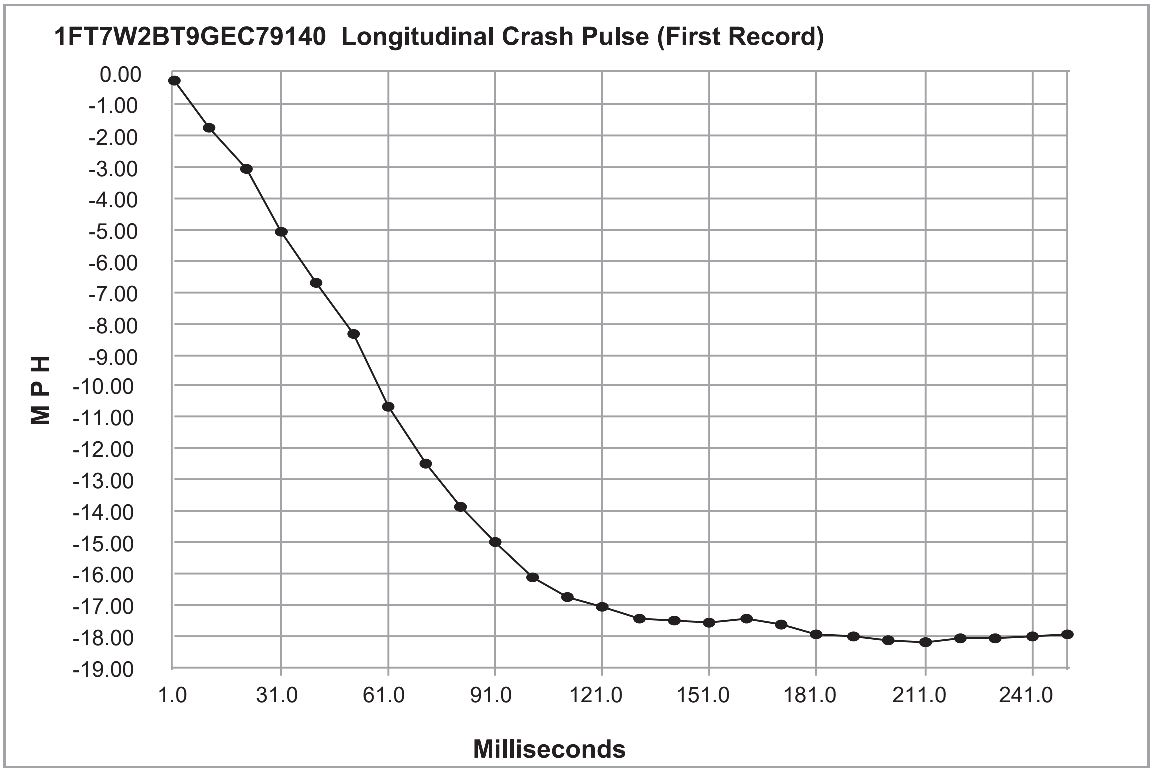
Pre-Crash Data -5 to 0 sec [2 samples/sec] (First Record)

Times (sec)	Speed vehicle indicated MPH [km/h]	Accelerator pedal, % full	Service brake, on/off	Engine RPM	ABS activity (engaged, non-engaged)	Brake Powertrain Torque Request	Driver Gear Selection
- 5.0	52 [84]	24.1	Off	1,270	non-engaged	No	Drive
- 4.5	52 [83]	24.3	Off	1,264	non-engaged	No	Drive
- 4.0	52 [83]	24.0	Off	1,262	non-engaged	No	Drive
- 3.5	52 [83]	23.8	Off	1,256	non-engaged	No	Drive
- 3.0	52 [83]	23.7	Off	1,256	non-engaged	No	Drive
- 2.5	51 [82]	23.5	Off	1,254	non-engaged	No	Drive
- 2.0	51 [82]	23.0	Off	1,250	non-engaged	No	Drive
- 1.5	51 [82]	23.0	Off	1,246	non-engaged	No	Drive
- 1.0	51 [82]	23.0	Off	1,246	non-engaged	No	Drive
- 0.5	51 [82]	22.9	Off	1,242	non-engaged	No	Drive
0.0	50 [81]	0.0	On	1,174	non-engaged	No	Drive

Pre-Crash Data -5 to 0 sec [10 samples/sec] (First Record)

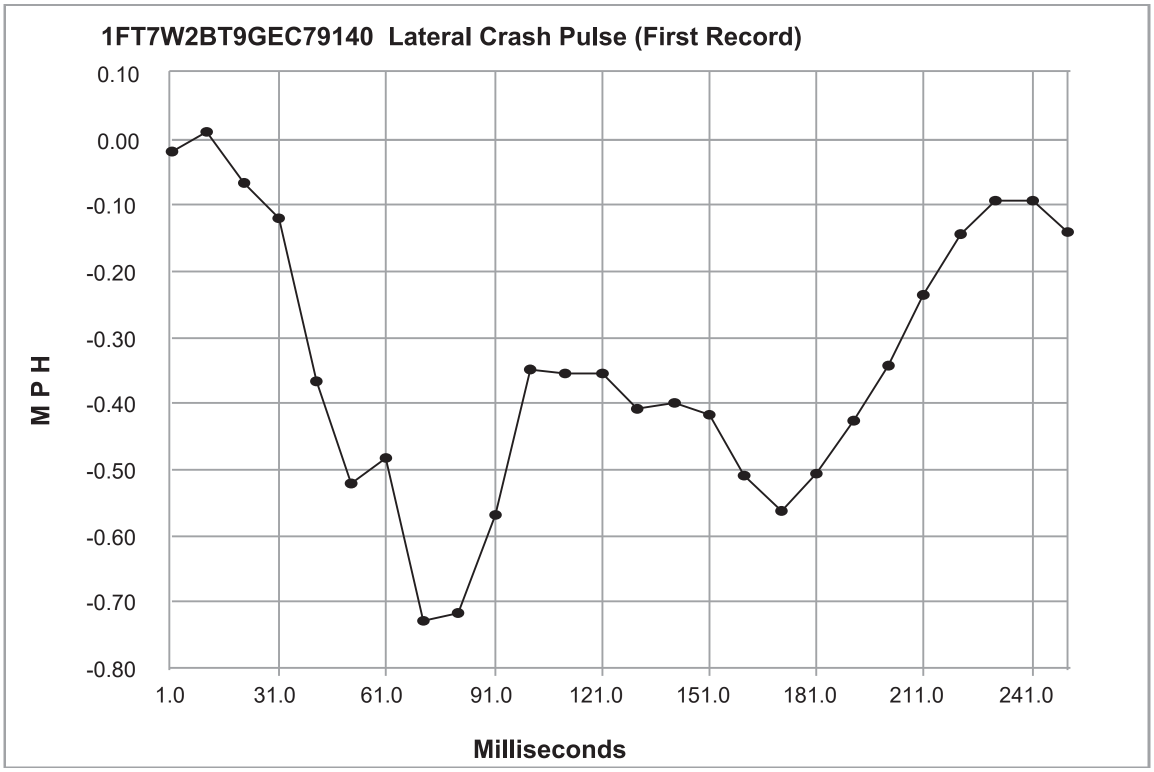
Times (sec)	Steering Wheel Angle (degrees)	Stability Control Lateral Acceleration (g)	Stability Control Longitudinal Acceleration (g)	Stability Control Yaw Rate (deg/sec)	Stability Control Roll Rate (deg/sec)
- 5.0	0.0	0.007	-0.021	1.12	-3.12
- 4.9	0.0	0.063	-0.021	1.37	-3.12
- 4.8	0.0	-0.016	-0.021	1.12	-3.12
- 4.7	0.0	0.064	-0.021	1.37	-3.12
- 4.6	0.0	-0.076	-0.021	1.12	-3.12
- 4.5	0.0	-0.016	-0.021	0.5	-3.12
- 4.4	0.0	-0.056	-0.021	0.75	-3.12
- 4.3	0.0	-0.036	-0.021	0.25	-3.12
- 4.2	0.0	0.026	-0.021	1.12	-3.12
- 4.1	0.0	0.059	-0.021	1.5	-3.12
- 4.0	0.0	0.048	-0.021	1.25	-3.12
- 3.9	0.0	0.048	-0.021	1.12	-3.12
- 3.8	0.0	0.03	-0.021	0.87	-3.12
- 3.7	0.0	-0.066	-0.021	0.75	-3.12
- 3.6	0.0	0.013	-0.021	0.5	-3.12
- 3.5	0.0	-0.065	-0.021	0.75	-3.12
- 3.4	0.0	0.076	-0.021	1.62	-3.12
- 3.3	0.0	0.051	-0.021	0.75	-3.12
- 3.2	0.0	0.063	-0.021	1.75	-3.12
- 3.1	0.0	0.03	-0.021	0.12	-3.12
- 3.0	0.0	-0.02	-0.021	0.87	-3.12
- 2.9	0.0	-0.071	-0.021	0.62	-3.12
- 2.8	0.0	0.052	-0.021	1.5	-3.12
- 2.7	0.0	-0.004	-0.021	1.5	-3.12
- 2.6	0.0	0.035	-0.021	1.25	-3.12
- 2.5	0.0	0.064	-0.021	1.25	-3.12
- 2.4	0.0	0.012	-0.021	1.12	-3.12
- 2.3	0.0	0.03	-0.021	1.12	-3.12
- 2.2	0.0	-0.026	-0.021	0.75	-3.12
- 2.1	0.0	0.002	-0.021	0.75	-3.12
- 2.0	0.0	0.007	-0.021	1.12	-3.12
- 1.9	0.0	0.029	-0.021	1.87	-3.12
- 1.8	0.0	0.06	-0.021	1.25	-3.12
- 1.7	0.0	0.047	-0.021	1.25	-3.12
- 1.6	0.0	0.028	-0.021	0.87	-3.12
- 1.5	0.0	0.018	-0.021	0.87	-3.12
- 1.4	0.0	-0.01	-0.021	0.5	-3.12
- 1.3	0.0	0.029	-0.021	1.12	-3.12
- 1.2	0.0	0.033	-0.021	1.0	-3.12
- 1.1	0.0	0.046	-0.021	0.75	-3.12
- 1.0	0.0	0.03	-0.021	1.37	-3.12
- 0.9	0.0	0.056	-0.021	0.12	-3.12
- 0.8	0.0	-0.025	-0.021	0.5	-3.12
- 0.7	0.0	0.027	-0.021	0.5	-3.12
- 0.6	0.0	-0.078	-0.021	0.12	-3.12
- 0.5	0.0	0.032	-0.021	0.0	-3.12
- 0.4	0.0	-0.048	-0.021	0.25	-3.12
- 0.3	0.0	0.069	-0.021	-0.37	-3.12
- 0.2	0.0	-0.043	-0.021	-0.62	-3.12
- 0.1	0.0	0.06	-0.021	1.12	-3.12
0.0	0.0	0.061	-0.021	0.87	-3.12

BOSCH CDR CRASH DATA RETRIEVAL



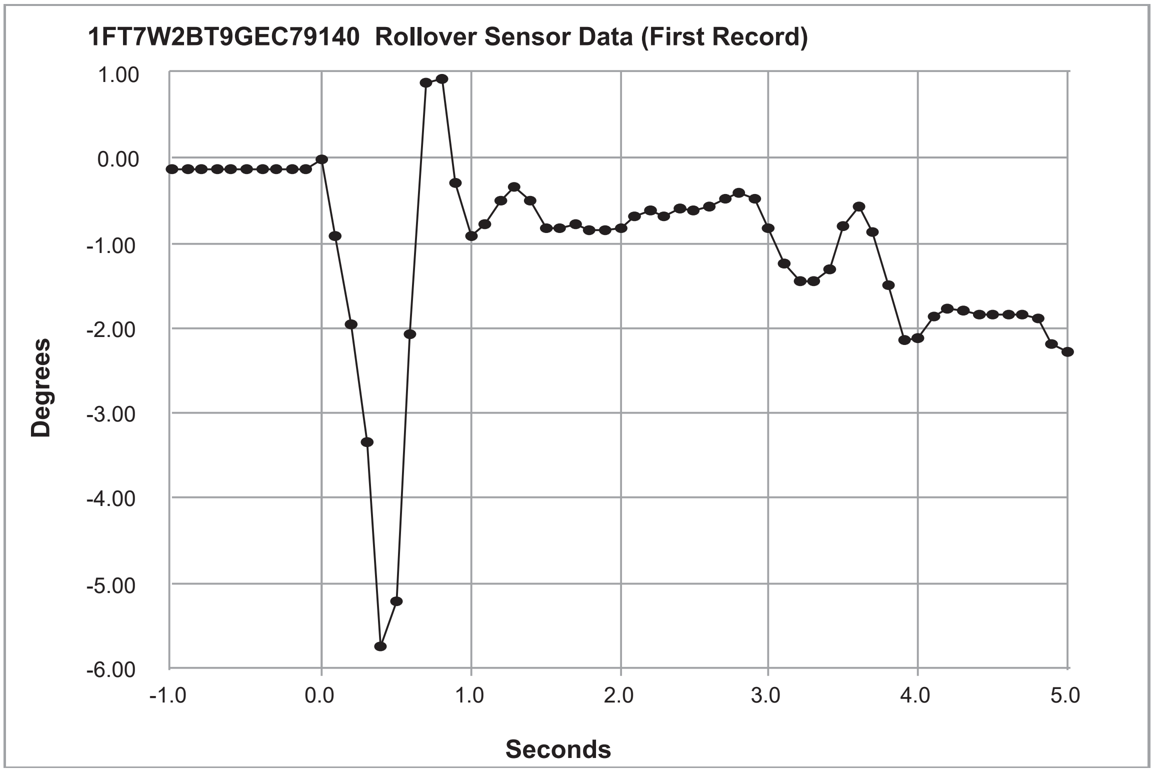
Longitudinal Crash Pulse (First Record)

Time (msec)	Delta-V, longitudinal (MPH)	Delta-V, longitudinal (km/h)
1.0	-0.25	-0.40
11.0	-1.79	-2.87
21.0	-3.10	-4.99
31.0	-5.10	-8.20
41.0	-6.73	-10.82
51.0	-8.35	-13.43
61.0	-10.64	-17.12
71.0	-12.46	-20.06
81.0	-13.88	-22.34
91.0	-14.96	-24.07
101.0	-16.13	-25.96
111.0	-16.76	-26.97
121.0	-17.08	-27.49
131.0	-17.44	-28.07
141.0	-17.48	-28.14
151.0	-17.59	-28.30
161.0	-17.45	-28.08
171.0	-17.62	-28.35
181.0	-17.90	-28.81
191.0	-17.99	-28.95
201.0	-18.14	-29.20
211.0	-18.16	-29.23
221.0	-18.08	-29.10
231.0	-18.06	-29.07
241.0	-17.99	-28.95
251.0	-17.92	-28.83



Lateral Crash Pulse (First Record)

Time (msec)	Delta-V, lateral (MPH)	Delta-V, lateral (km/h)
1.0	-0.02	-0.03
11.0	0.01	0.02
21.0	-0.07	-0.11
31.0	-0.12	-0.19
41.0	-0.37	-0.59
51.0	-0.52	-0.84
61.0	-0.48	-0.78
71.0	-0.73	-1.17
81.0	-0.72	-1.15
91.0	-0.57	-0.92
101.0	-0.35	-0.56
111.0	-0.35	-0.57
121.0	-0.35	-0.57
131.0	-0.41	-0.66
141.0	-0.40	-0.64
151.0	-0.42	-0.67
161.0	-0.51	-0.82
171.0	-0.56	-0.91
181.0	-0.51	-0.82
191.0	-0.43	-0.69
201.0	-0.34	-0.55
211.0	-0.23	-0.38
221.0	-0.14	-0.23
231.0	-0.09	-0.15
241.0	-0.09	-0.15
251.0	-0.14	-0.22



Rollover Sensor Data (First Record)

Time (sec)	Vehicle roll angle (degrees)
-1.0	-0.14
-0.9	-0.13
-0.8	-0.13
-0.7	-0.13
-0.6	-0.13
-0.5	-0.13
-0.4	-0.13
-0.3	-0.13
-0.2	-0.13
-0.1	-0.13
0.0	-0.02
0.1	-0.91
0.2	-1.96
0.3	-3.35
0.4	-5.76
0.5	-5.22
0.6	-2.07
0.7	0.89
0.8	0.93
0.9	-0.29
1.0	-0.92
1.1	-0.77
1.2	-0.5
1.3	-0.33
1.4	-0.5
1.5	-0.82
1.6	-0.82
1.7	-0.78
1.8	-0.85
1.9	-0.85
2.0	-0.83
2.1	-0.7
2.2	-0.62
2.3	-0.68
2.4	-0.59
2.5	-0.61
2.6	-0.57
2.7	-0.49
2.8	-0.41
2.9	-0.47
3.0	-0.82
3.1	-1.25
3.2	-1.44
3.3	-1.44
3.4	-1.3
3.5	-0.79
3.6	-0.56
3.7	-0.87
3.8	-1.5
3.9	-2.15
4.0	-2.12
4.1	-1.87
4.2	-1.77
4.3	-1.78
4.4	-1.85
4.5	-1.85
4.6	-1.84
4.7	-1.84
4.8	-1.88
4.9	-2.18
5.0	-2.29

Hexadecimal Data

Data that the vehicle manufacturer has specified for data retrieval is shown in the hexadecimal data section of the CDR report. The hexadecimal data section of the CDR report may contain data that is not translated by the CDR program. The control module contains additional data that is not retrievable by the CDR system.

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00 00 00 00

44 43 33 54 2D 31 34 42 33 32 31 2D 44 43 00 00 00 00 00 00 00 00 00 00

39 30 31 36 31 35 37 34 30 30 30 30 30 30 30 30

43 54 34 33 2D 31 34 43 30 32 38 2D 41 42 00 00 00 00 00 00 00 00 00 00

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B9 47 27 10 00 00 00 00 00 00 00 00 00 00 00 00

1C 7D EB 49 00 00 00 00 00 00 00 00 00 00 00 00

00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00

E2 27 27 10 00 00 00 00 00 00 00 00 00 00 00 00

1C 78 2D 16 00 00 00 00 00 00 00 00 00 00 00 00

31 46 54 37 57 32 42 54 39 47 45 43 37 39 31 34 30

31 46 54 37 57 32 42 54 39 47 45 43 37 39 31 34 30 00 00 00 00 00 00 00
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Event Record 1

29 1A 00 00 2A 1A 00 00 77 CB 1F 00 E8 0A 00 00 58 3F 00 00 57 FD FF FF 98 18 2B FF
56 3B D5 00 13 50 00 00 46 E8 D4 00 9E ED D4 00 33 F2 D4 00 22 F9 D4 00 CC FE D4 00
6E 04 D5 00 67 0C D5 00 C1 12 D5 00 AF 17 D5 00 6C 1B D5 00 81 1F D5 00 B0 21 D5 00
CE 22 D5 00 0F 24 D5 00 36 24 D5 00 92 24 D5 00 16 24 D5 00 AE 24 D5 00 AC 25 D5 00
F7 25 D5 00 80 26 D5 00 93 26 D5 00 49 26 D5 00 38 26 D5 00 F9 25 D5 00 B7 25 D5 00
99 C4 2A FF B4 C4 2A FF 6F C4 2A FF 40 C4 2A FF 64 C3 2A FF DA C2 2A FF FD C2 2A FF
21 C2 2A FF 2C C2 2A FF AF C2 2A FF 73 C3 2A FF 6F C3 2A FF 6E C3 2A FF 3F C3 2A FF
48 C3 2A FF 36 C3 2A FF E5 C2 2A FF B5 C2 2A FF E7 C2 2A FF 2E C3 2A FF 79 C3 2A FF
D9 C3 2A FF 29 C4 2A FF 56 C4 2A FF 56 C4 2A FF 2E C4 2A FF 86 B2 1D AF 57 AD C5 AD
84 AE 01 AF 86 AE A3 AD A0 AD BC AD 8A AD 8A AD 9C AD FA AD 33 AE 02 AE 45 AE 39 AE
53 AE 91 AE C4 AE 9B AE 9E AD 6E AC E6 AB E3 AB 49 AC B6 AD 5A AE 80 AD BA AB E7 A9
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Appendix B:

Test 2016 Ford F-250 CDR Report

IMPORTANT NOTICE: Robert Bosch LLC and the manufacturers whose vehicles are accessible using the CDR System urge end users to use the latest production release of the Crash Data Retrieval system software when viewing, printing or exporting any retrieved data from within the CDR program. Using the latest version of the CDR software is the best way to ensure that retrieved data has been translated using the most current information provided by the manufacturers of the vehicles supported by this product.

CDR File Information

User Entered VIN	1FT7W2BTXGED47610
User	AG
Case Number	22-3104
EDR Data Imaging Date	05/15/2023
Crash Date	
Filename	1FT7W2BTXGED47610_ACM.CDRX
Saved on	Monday, May 15 2023 at 13:42:08
Imaged with CDR version	Crash Data Retrieval Tool 23.1.1
Imaged with Software Licensed to (Company Name)	Mecanica Scientific Services Corp.
Reported with CDR version	Crash Data Retrieval Tool 23.1.1
Reported with Software Licensed to (Company Name)	Mecanica Scientific Services Corp.
EDR Device Type	Airbag Control Module
ACM Adapter Detected During Download	No
Event(s) recovered	locked frontal event

Comments

Imaging Authority: Consent
Imaging Method: DLC in vehicle
Power: Vehicle
VCI: CanPlus
Vehicle Cable: 287
Adapter: None
Drive Tire Size: LT275/65R20
Recommended Tire Size: LT 275/65R20E

The retrieval of this data has been authorized by the vehicle's owner, or other legal authority such as a court order or search warrant, as indicated by the CDR tool user on Monday, May 15 2023 at 13:42:08.

Data Limitations

Restraints Control Module Recorded Crash Events:
Deployment Events cannot be overwritten or cleared from the Restraints Control Module (RCM). Once the RCM has deployed any airbag device, the RCM must be replaced. The data from events which did not qualify as deployable events can be overwritten by subsequent events. The RCM can store up to two deployment events.

Airbag Module Data Limitations:

- Restraints Control Module Recorded Vehicle Forward Velocity Change reflects the change in forward velocity that the sensing system experienced from the point of algorithm wake up. It is not the speed the vehicle was traveling before the event. Note that the vehicle speed is recorded separately five seconds prior to algorithm wake up. This data should be examined in conjunction with other available physical evidence from the vehicle and scene when assessing occupant or vehicle forward velocity change.
- Event Recording Complete will indicate if data from the recorded event has been fully written to the RCM memory or if it has been interrupted and not fully written.
- If power to the Airbag Module is lost during a crash event, all or part of the crash record may not be recorded.
- For 2011 Ford Mustangs, the Steering Wheel Angle parameter indicates the change in steering wheel angle from the previously recorded sample value and does not represent the actual steering wheel position.

Airbag Module Data Sources:

- Event recorded data are collected either INTERNALLY or EXTERNALLY to the RCM.

  - INTERNAL DATA is measured, calculated, and stored internally, sensors external to the RCM include the following:
  > The Driver and Passenger Belt Switch Circuits are wired directly to the RCM.
  > The Driver's Seat Track Position Switch Circuit is wired directly to the RCM.
  > The Side Impact Sensors (if equipped) are located on the side of vehicle and are wired directly to the RCM.
  > The Occupant Classification Sensor is located in the front passenger seat and transmits data directly to the RCM on high-speed CAN bus.
  > Front Impact Sensors (right and left) are located at the front of vehicle and are wire directly to the RCM.

- EXTERNAL DATA recorded by the RCM are data collected from the vehicle communication network from various sources such as Powertrain Control Module, Brake Module, etc.

02007_RCM-RC6_r002

BOSCH CDR CRASH DATA RETRIEVAL

System Status at Time of Retrieval

VIN as programmed into RCM at factory	1FT7W2BTXGED47610
Current VIN from PCM	1FT7W2BTXGED47610
Ignition cycle, download (first record)	7,535
Ignition cycle, download (second record)	N/A
Restraints Control Module Part Number	DC3T-14B321-DC
Restraints Control Module Serial Number	9024789300000000
Restraints Control Module Software Part Number (Version)	CT43-14C028-AB
Left/Center Frontal Restraints Sensor Serial Number	1CA487D0
Left Side Restraint Sensor 1 Serial Number	92962A20
Left Side Restraint Sensor 2 Serial Number	1CA0DC9C
Right Frontal Restraints Sensor Serial Number	00000000
Right Side Restraint Sensor 1 Serial Number	7D963720
Right Side Restraints Sensor 2 Serial Number	1CA092D3

System Status at Event (First Record)

Recording Status	Locked Record
Complete file recorded (yes,no)	Yes
Multi-event, number of events (1,2)	1
Time from event 1 to 2 (msec)	N/A
Lifetime Operating Timer at event time zero (seconds)	8,833,695
Key-on Timer at event time zero (seconds)	325
Vehicle voltage at time zero (Volts)	12.312
Energy Reserve Mode entered during event (Y/N)	No
Time Driver Front Satellite Sensor Lost Relative to Time Zero (msec)	16.5

Faults Present at Start of Event (First Record)

No Faults Recorded

BOSCH CDR CRASH DATA RETRIEVAL

Deployment Data (First Record)

Frontal airbag deployment, time to first stage deployment, driver (msec)	21.5
Pretensioner (retractor) deployment, time to fire, driver (msec)	8.5
Frontal airbag deployment, time to first stage deployment, front passenger (msec)	21.5
Pretensioner (retractor) deployment, time to fire, right front passenger (msec)	8.5
Maximum delta-V, longitudinal (MPH [km/h])	-17.96 [-28.90]
Time, maximum delta-V longitudinal (msec)	300
Maximum delta-V, lateral (MPH [km/h])	1.75 [2.81]
Time, maximum delta-V lateral (msec)	300
Left or center front, satellite Sensor discriminating deployment	Yes
Left or center, front satellite Sensor safing	Yes
Right, front satellite sensor discriminating deployment	Yes
RCM, front sensor discriminating deployment	Yes
RCM, front sensor safing	Yes
Longitudinal Delta-V Time Zero Offset	4.0 ms
Lateral Delta-V Time Zero Offset	4.0 ms
Roll Angle Time Zero Offset	44.0 ms

BOSCH CDR CRASH DATA RETRIEVAL

Pre-Crash Data -1 sec (First Record)

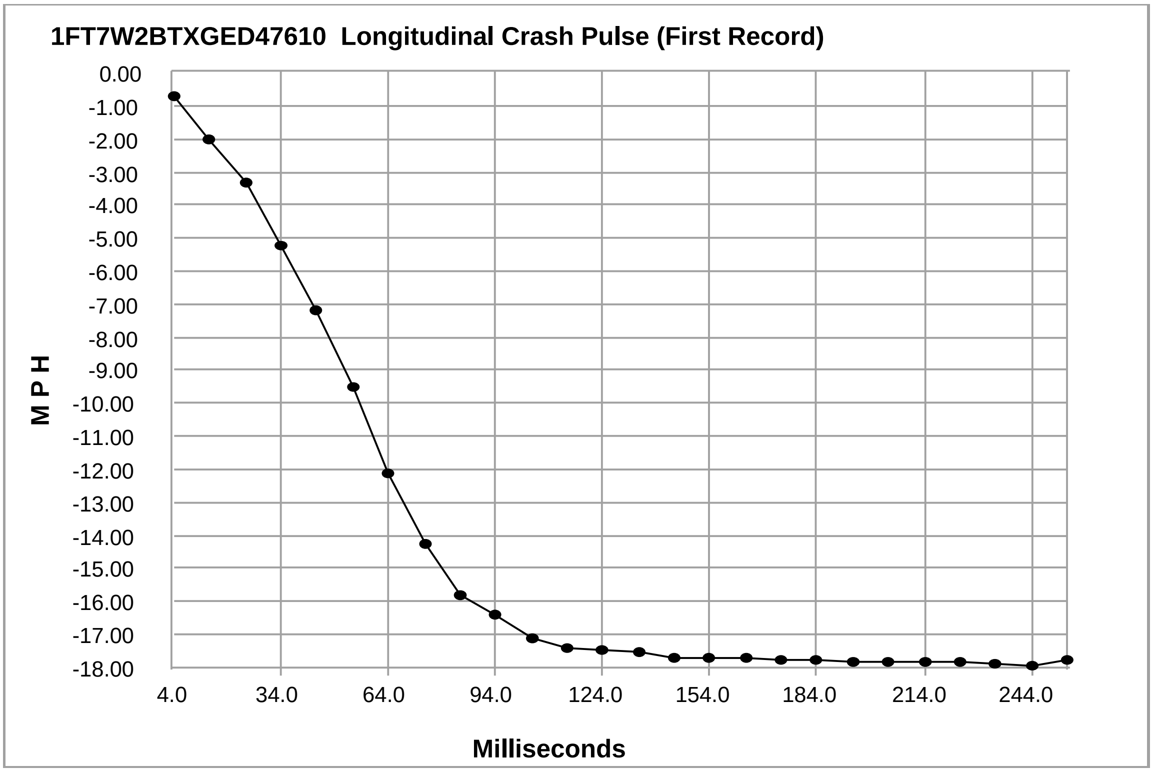
Ignition cycle, crash	7,532
Frontal air bag warning lamp, on/off	Off
Frontal air bag suppression switch status, front passenger	Not Active
Safety belt status, driver	Driver Buckled
Brake Telltale	On
ABS Telltale	Off
Powertrain Wrench Telltale	Off
Speed Control Telltale	Off
MIL Telltale	On

Pre-Crash Data -5 to 0 sec [2 samples/sec] (First Record)

Times (sec)	Speed vehicle indicated MPH [km/h]	Accelerator pedal, % full	Service brake, on/off	Engine RPM	ABS activity (engaged, non-engaged)	Brake Powertrain Torque Request	Driver Gear Selection
- 5.0	43 [70]	0.0	Off	0	non-engaged	No	Neutral
- 4.5	45 [72]	0.0	Off	0	non-engaged	No	Neutral
- 4.0	46 [74]	0.0	Off	0	non-engaged	No	Neutral
- 3.5	47 [75]	0.0	Off	0	non-engaged	No	Neutral
- 3.0	47 [75]	0.0	Off	0	non-engaged	No	Neutral
- 2.5	47 [76]	0.0	Off	0	non-engaged	No	Neutral
- 2.0	47 [76]	0.0	Off	0	non-engaged	No	Neutral
- 1.5	48 [77]	0.0	Off	0	non-engaged	No	Neutral
- 1.0	48 [77]	0.0	Off	0	non-engaged	No	Neutral
- 0.5	48 [78]	0.0	Off	0	non-engaged	No	Neutral
0.0	48 [78]	0.0	Off	0	non-engaged	No	Neutral

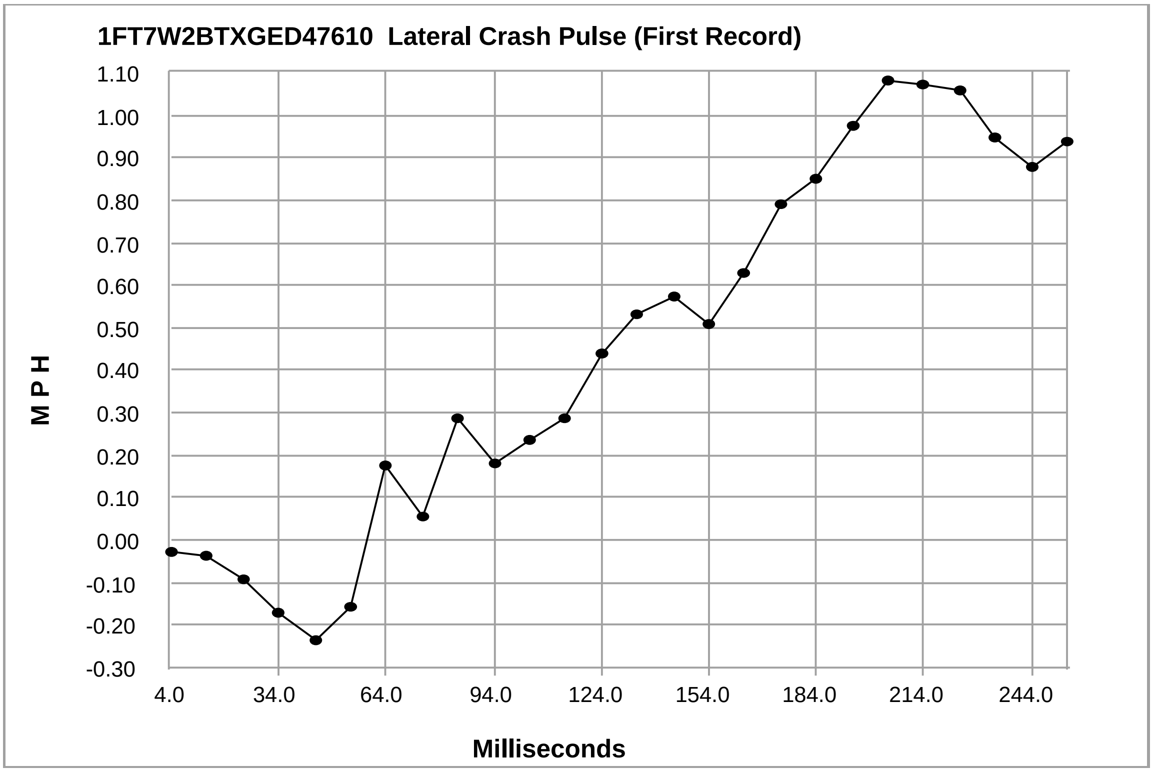
Pre-Crash Data -5 to 0 sec [10 samples/sec] (First Record)

Times (sec)	Steering Wheel Angle (degrees)	Stability Control Lateral Acceleration (g)	Stability Control Longitudinal Acceleration (g)	Stability Control Yaw Rate (deg/sec)	Stability Control Roll Rate (deg/sec)
- 5.0	6.5	0.012	0.057	1.5	3.62
- 4.9	6.8	0.022	0.062	1.62	0.62
- 4.8	7.8	0.049	0.054	0.75	-1.87
- 4.7	8.5	0.012	0.046	0.62	-2.12
- 4.6	8.5	-0.029	0.059	0.37	-2.75
- 4.5	7.6	-0.011	0.04	0.12	0.25
- 4.4	6.8	-0.09	0.079	-0.25	2.5
- 4.3	6.7	0.023	0.04	-1.62	0.0
- 4.2	6.1	-0.007	0.022	-0.5	1.25
- 4.1	5.5	0.009	0.019	1.12	4.12
- 4.0	6.6	0.046	0.035	1.25	0.75
- 3.9	8.5	0.012	0.059	0.5	1.87
- 3.8	8.5	0.037	-0.018	0.5	-1.62
- 3.7	8.6	-0.06	0.04	0.62	-0.37
- 3.6	7.6	0.028	0.032	0.0	0.75
- 3.5	6.1	-0.132	-0.058	0.0	2.62
- 3.4	5.8	-0.012	0.019	1.12	2.12
- 3.3	6.3	0.03	-0.041	1.25	0.75
- 3.2	6.6	-0.071	-0.135	0.5	1.37
- 3.1	6.7	0.055	0.079	0.12	0.12
- 3.0	6.7	-0.015	0.019	0.62	1.37
- 2.9	7.5	-0.038	0.0	0.75	1.62
- 2.8	8.1	-0.054	0.027	0.5	-0.62
- 2.7	7.7	0.013	0.04	0.75	-0.37
- 2.6	7.0	-0.019	-0.053	-0.12	-0.62
- 2.5	6.6	-0.078	-0.018	-0.5	0.75
- 2.4	5.8	-0.087	0.0	-0.87	2.0
- 2.3	5.8	0.003	0.0	0.12	0.5
- 2.2	5.8	-0.089	-0.043	-0.5	1.37
- 2.1	5.3	-0.068	-0.036	-0.75	3.5
- 2.0	5.6	0.038	0.059	0.75	3.37
- 1.9	6.2	0.048	0.0	3.12	2.75
- 1.8	8.8	0.071	0.0	2.25	0.87
- 1.7	9.7	0.034	0.046	1.62	0.12
- 1.6	9.5	0.01	0.032	0.87	-1.25
- 1.5	9.1	-0.069	-0.095	-0.75	-1.62
- 1.4	6.8	-0.081	0.012	-0.5	0.62
- 1.3	3.8	-0.107	0.002	-0.12	2.25
- 1.2	4.2	-0.104	-0.063	-1.0	2.12
- 1.1	4.1	-0.066	-0.039	-1.0	-0.25
- 1.0	4.0	-0.124	-0.055	-0.62	1.25
- 0.9	4.0	-0.028	0.007	-0.5	5.0
- 0.8	3.8	-0.007	0.0	0.5	6.75
- 0.7	6.1	-0.03	0.04	1.87	6.37
- 0.6	9.2	0.132	0.044	2.12	0.37
- 0.5	9.0	0.132	-0.013	2.0	-4.12
- 0.4	9.8	-0.003	0.0	1.62	-3.0
- 0.3	10.7	0.032	0.082	1.25	-2.37
- 0.2	8.0	0.002	0.0	-0.25	-1.75
- 0.1	7.3	-0.142	-0.066	-1.12	1.75
0.0	5.2	-0.07	0.0	-0.25	2.12



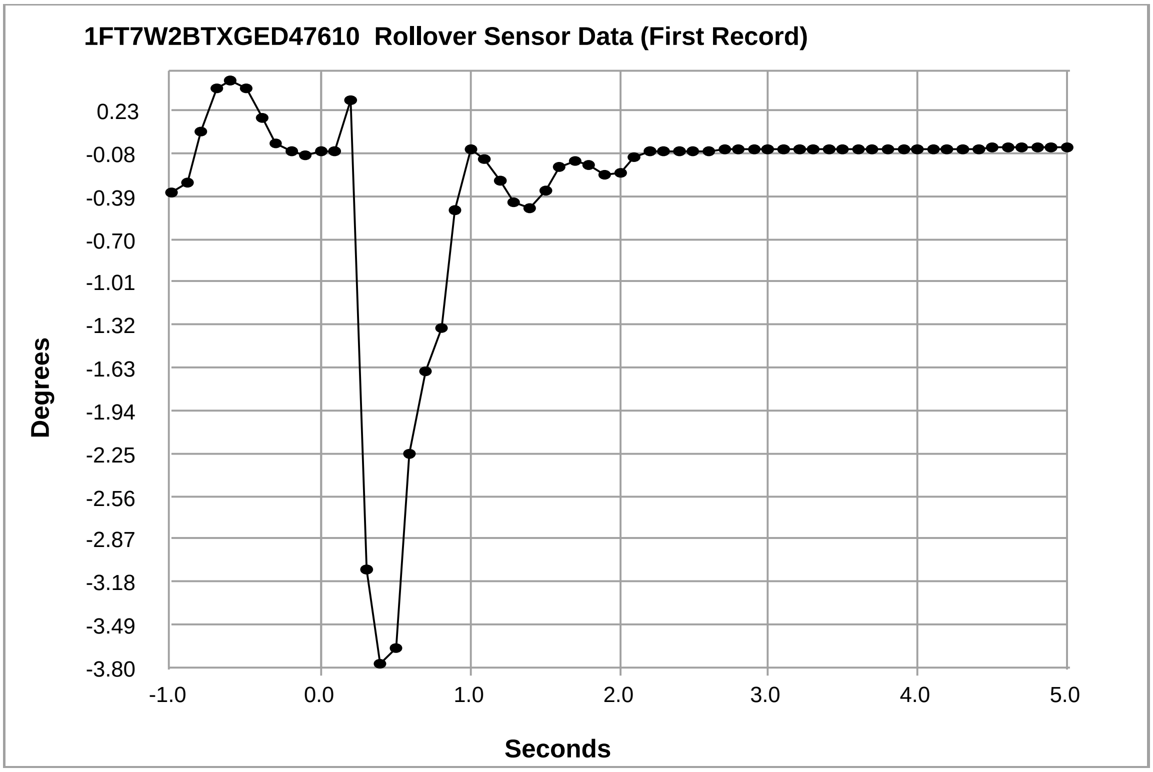
Longitudinal Crash Pulse (First Record)

Time (msec)	Delta-V, longitudinal (MPH)	Delta-V, longitudinal (km/h)
4.0	-0.69	-1.11
14.0	-2.02	-3.26
24.0	-3.35	-5.39
34.0	-5.24	-8.44
44.0	-7.17	-11.55
54.0	-9.48	-15.25
64.0	-12.12	-19.51
74.0	-14.26	-22.95
84.0	-15.78	-25.39
94.0	-16.42	-26.42
104.0	-17.10	-27.52
114.0	-17.38	-27.97
124.0	-17.45	-28.08
134.0	-17.55	-28.25
144.0	-17.69	-28.47
154.0	-17.73	-28.54
164.0	-17.71	-28.50
174.0	-17.76	-28.58
184.0	-17.77	-28.60
194.0	-17.81	-28.66
204.0	-17.84	-28.72
214.0	-17.81	-28.66
224.0	-17.85	-28.72
234.0	-17.91	-28.82
244.0	-17.92	-28.84
254.0	-17.75	-28.57



Lateral Crash Pulse (First Record)

Time (msec)	Delta-V, lateral (MPH)	Delta-V, lateral (km/h)
4.0	-0.03	-0.05
14.0	-0.04	-0.06
24.0	-0.09	-0.15
34.0	-0.17	-0.27
44.0	-0.24	-0.38
54.0	-0.16	-0.25
64.0	0.18	0.28
74.0	0.06	0.09
84.0	0.29	0.46
94.0	0.18	0.29
104.0	0.24	0.38
114.0	0.29	0.46
124.0	0.44	0.71
134.0	0.53	0.86
144.0	0.57	0.92
154.0	0.51	0.82
164.0	0.63	1.01
174.0	0.79	1.27
184.0	0.85	1.37
194.0	0.97	1.57
204.0	1.08	1.74
214.0	1.07	1.72
224.0	1.06	1.70
234.0	0.95	1.52
244.0	0.88	1.41
254.0	0.94	1.51



Rollover Sensor Data (First Record)

Time (sec)	Vehicle roll angle (degrees)
-1.0	-0.36
-0.9	-0.29
-0.8	0.08
-0.7	0.38
-0.6	0.44
-0.5	0.39
-0.4	0.17
-0.3	0.0
-0.2	-0.07
-0.1	-0.1
0.0	-0.07
0.1	-0.07
0.2	0.29
0.3	-3.09
0.4	-3.77
0.5	-3.66
0.6	-2.26
0.7	-1.66
0.8	-1.34
0.9	-0.49
1.0	-0.05

Time (sec)	Vehicle roll angle (degrees)
1.1	-0.13
1.2	-0.28
1.3	-0.44
1.4	-0.48
1.5	-0.35
1.6	-0.18
1.7	-0.14
1.8	-0.16
1.9	-0.24
2.0	-0.22
2.1	-0.1
2.2	-0.07
2.3	-0.07
2.4	-0.07
2.5	-0.07
2.6	-0.07
2.7	-0.06
2.8	-0.06
2.9	-0.06
3.0	-0.06
3.1	-0.06

Time (sec)	Vehicle roll angle (degrees)
3.2	-0.06
3.3	-0.06
3.4	-0.06
3.5	-0.06
3.6	-0.06
3.7	-0.06
3.8	-0.06
3.9	-0.06
4.0	-0.06
4.1	-0.06
4.2	-0.06
4.3	-0.06
4.4	-0.05
4.5	-0.04
4.6	-0.04
4.7	-0.04
4.8	-0.04
4.9	-0.04
5.0	-0.04

Hexadecimal Data

Data that the vehicle manufacturer has specified for data retrieval is shown in the hexadecimal data section of the CDR report. The hexadecimal data section of the CDR report may contain data that is not translated by the CDR program. The control module contains additional data that is not retrievable by the CDR system.

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44 43 33 54 2D 31 34 42 33 32 31 2D 44 43 00 00 00 00 00 00 00 00 00 00

39 30 32 34 37 38 39 33 30 30 30 30 30 30 30 30

43 54 34 33 2D 31 34 43 30 32 38 2D 41 42 00 00 00 00 00 00 00 00 00 00

1C A4 87 D0 00 00 00 00 00 00 00 00 00 00 00 00

92 96 2A 20 00 00 00 00 00 00 00 00 00 00 00 00

1C A0 DC 9C 00 00 00 00 00 00 00 00 00 00 00 00

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1C A0 92 D3 00 00 00 00 00 00 00 00 00 00 00 00

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31 46 54 37 57 32 42 54 58 47 45 44 34 37 36 31 30 00 00 00 00 00 00 00
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Event Record 1

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81 02 05 00 B5 0B 05 00 24 13 05 00 6A 18 05 00 A2 1A 05 00 05 1D 05 00 FB 1D 05 00
39 1E 05 00 96 1E 05 00 12 1F 05 00 35 1F 05 00 21 1F 05 00 4D 1F 05 00 56 1F 05 00
77 1F 05 00 98 1F 05 00 7C 1F 05 00 9C 1F 05 00 D4 1F 05 00 DB 1F 05 00 45 1F 05 00
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73 1E FB FF 3F 1F FB FF DF 1E FB FF 13 1F FB FF 40 1F FB FF C7 1F FB FF 1B 20 FB FF
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FA 21 FB FF EF 21 FB FF 8B 21 FB FF 4D 21 FB FF 82 21 FB FF EB FD DB FD A3 FD AF FD
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A5 07 AC 07 0B 08 D0 07 D0 07 FE 07 F0 07 71 07 DC 07 D2 07 91 07 A9 07 99 07 D7 07
D0 07 F8 07 FC 07 C3 07 D0 07 F0 07 D2 07 42 07 8A 07 DC 07 E6 07 01 08 DC 07 B3 07
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Event Record 2


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Disclaimer of Liability

Appendix C:

Curriculum Vitae of Wesley Grimes

MECANICA SCIENTIFIC SERVICES

2812 N Norwalk, Suite 123
Mesa, Arizona 85215
(480) 655-0399

WESLEY GRIMES - CURRICULUM VITAE

POSITION

Director of forensic services at Mecanica Scientific Services Corporation. Mr. Grimes specializes in transportation crash analysis and reconstruction including the imaging (downloading) and analysis of data from passenger vehicle Event Data Recorders and Heavy Vehicle Event Data Recorders (HVEDR), vehicle performance testing and analysis. He also teaches about and utilizes computer simulation models, specifically the Human Vehicle Environment (HVE) computer simulation software. Mr. Grimes is also one of six instructors of the SAE Continuing Education Courses on *Accessing and Interpreting Heavy Vehicle Event Data Recorders* (Course ID # C1022) along with *Advanced Applications of Heavy Vehicle EDR Data* (Course ID # C1901)

AREAS OF EXPERTISE

- Event Data Recorder (EDR) data retrieval and analysis
- Reconstruction of accidents involving passenger vehicles and commercial trucks
- Performance analysis of vehicle systems, including heavy trucks, ADAS, CMS
- Instrumentation for vehicle performance testing
- Computer modeling of crashes using simulations
- Computer visualizations used in crash analysis
- Documentation of crash scenes using drone photos and ground based photography
- Documentation of vehicle damage using photography and 3-d scanners

EXPERIENCE

- February 2022 - Present
  Mecanica Scientific Services Corp., Mesa, Arizona
- February 1994 - February 2022
  Collision Engineering Associates, Inc., Mesa, Arizona.
- Nov. 1979 - April 1980 & July 1981 - February 1994
  Cromack Engineering Associates, Inc., Tempe, Arizona.

EDUCATION

- Brigham Young University, 1978 - 1979, Engineering courses
- Arizona Tech, 1981, Computer programming
- Mesa Community College, 1986 - 1989, Engineering courses
- Arizona State University, 1988 - 1992, Mechanical Engineering, BSME

PROFESSIONAL MEMBERSHIPS

Societies:

- Association for the Advancement of Automotive Medicine, AAAM-(past member)
- Society of Automotive Engineers, SAE
- Member, Accident Investigation and Reconstruction Practices Committee, SAE, 1982-2012
- Vice President, ATB User's Group, 1996, 1997
- National Association of Professional Accident Reconstructionists, NAPARS
- Southwest Association of Technical Accident Investigators, SATAI
- American Society of Media Photographers, ASMP
- International Association of Forensic and Security Metrology, IAFSM

Registrations/Certificates:

- Professional Engineer, Arizona certificate no. 26907
- Professional Engineer, Louisiana license no. 31362 (2004-2022)
- Society of Automotive Engineers, Accident Reconstruction Certificate, 2016
- FAA Drone Airman Certificate

PRESENTATIONS/ OTHER ACTIVITIES / AWARDS

- Session Co-organizer for SAE at the annual SAE World Congress, Accident Reconstruction: Technology and Animation, 1991 - 2000
- Instructor - The HVE Developers Conference in San Francisco, CA, 1996
- Instructor - Car Crashes and Occupant Injuries, AAAM Course, 1997
- Instructor - The HVE Developers Conference in Scottsdale, AZ, 1997
- Accident Reconstruction: Animation vs Simulation, Nevada Trial Lawyers Association, 1 CLE credit, August 1997
- Accident Reconstruction and the Seat Belt Defense, Teilborg, Sanders & Parks, P.C., 1 CLE credit, November 1997
- Tractor Trailer Jackknife Avoidance and Decision Driving Techniques, Wisconsin Decision Driving Center, 1998
- Instructor - 3-D Human Simulation use GATB, The HVE Forum in New Orleans, LA, 1998
- Instructor - The HVE Developers Conference in New Orleans, LA, 1998
- Instructor - The HVE Developers Conference in Atlanta, GA, 1999
- Instructor - The HVE Conference in San Diego, CA, 2000
- Instructor - The HVE Conference in Santa Fe, NM, 2001
- Received the Forest R. McFarland Award as “A Key Contributor to the SAE International Congress Meeting, 1991-2000,” presented 2002
- Instructor - The HVE Conference in New Orleans, LA, 2002
- Instructor - SATAI Spring Conference in Las Vegas, NV, 2003
- Instructor - The HVE Conference in Las Vegas, NV, 2003
- Using ATB Under the HVE Environment - A Case Study, The ATB User's Group Conference in Salt Lake City, UT, 2004
- Instructor - The HVE Forum in San Francisco, CA, 2004
- HTTG Heavy Truck Brake Testing in East Liberty, OH, 2004
- Instructor - The HVE Forum in Miami, FL, 2005

- Instructor - Advanced Case Studies using HVE, The HVE Forum in Miami, FL, 2005
- Instructor - The HVE Forum in Phoenix, AZ, 2006
- Instructor - Advanced Case Studies using HVE, The HVE Forum in Phoenix, AZ, 2006
- Instructor - The HVE Forum in San Antonio, TX, 2007
- Instructor - Advanced Case Studies using HVE, The HVE Forum in San Antonio, TX, 2007
- Instructor - The HVE Forum in San Diego, CA, 2008
- Instructor - Advanced Case Studies using HVE, The HVE Forum in San Diego, CA, 2008
- Instructor - Advanced Digital Photography for Accident Reconstruction, SATAI Conference in San Diego, CA, November, 2010
- Instructor - The HVE Forum in Scottsdale, AZ, 2011
- Instructor - Advanced Case Studies using HVE, The HVE Forum in New Orleans, LA, 2012
- Instructor - Using 3D Laser Scanners in Accident Reconstruction, International Association of Forensic and Security Metrology Annual Conference, 2015
- Motorcycle Crash Test Team Member - ARC-CSI Crash Conference, Las Vegas, NV, 2016
- Instructor - Advanced Digital Photography for Accident Reconstruction, ARC-CSI Crash Conference, Las Vegas, NV, 2016
- ARC-CSI - Motorcycle Drag Factor Testing, Las Vegas, NV, 2016
- Instructor - Two Blocks of Instruction: CloudCompare, Photo Substitution Work flow, FARO Scene 7 Update Training, 2017
- Instructor - Using Pix4d in Accident Reconstruction, IAFSM Conference, Atlanta, GA, 2017
- Instructor - Vehicle Crash Reconstruction: Principles and Technology, SAE Course, Phoenix, AZ, 2017
- Instructor - Vehicle Crash Reconstruction: Principles and Technology, SAE Course, Segundo, CA, 2018
- Instructor - Vehicle Crash Reconstruction: Principles and Technology, SAE Course, Aberdeen Proving Ground, MD, 2018
- Instructor - Vehicle Crash Reconstruction: Principles and Technology, SAE Course, Herndon, VA, 2018
- Instructor - Accident Reconstruction with Heavy Vehicle Event Data Recorders, MSC Recon, Mesa, AZ, 2018
- Instructor - Vehicle Crash Reconstruction: Principles and Technology, SAE Course, Phoenix, AZ, 2018
- Instructor - A Moving Picture's Worth a Thousand Words: Animated Accident Reconstruction, Arizona Association for Justice, Phoenix, AZ, 2018
- Instructor - Vehicle Crash Reconstruction: Principles and Technology, SAE Course, Phoenix, AZ, 2019
- Instructor - Heavy Vehicle Topics, SATAI Summer Conference, July, 2019
- Instructor - Vehicle Crash Reconstruction: Principles and Technology, SAE Course, Denver, CO, 2019
- Instructor - Advanced Applications of Heavy Vehicle EDR Data, SAE Course, Oxnard, CA, 2019
- Instructor - Vehicle Crash Reconstruction: Principles and Technology, SAE Course, Scottsdale, AZ, 2020

- Instructor - Using Freightliner New Cascadia ECM Data in Accident Reconstruction, NAPARS, 2020
- Instructor - Advanced Applications of Heavy Vehicle EDR Data, SAE Course, Oxnard, CA, 2021
- Instructor - Accessing and Interpreting Heavy Vehicle Event Data Recorders, SAE Course, Oxnard, CA, 2021
- Instructor - Advanced Applications of Heavy Vehicle EDR Data, SAE Course, Oxnard, CA, 2021
- Instructor - Advanced HVE, The HVE Forum online, 2022
- Instructor - Accessing and Interpreting Heavy Vehicle Event Data Recorders, SAE Course C1022, Appleton, WI, 2022
- Instructor - Advanced Applications of Heavy Vehicle EDR Data, SAE Course C1901, Appleton, WI, 2022
- Instructor - Advanced HVE, The HVE Forum in Fort Myers, FL, 2023
- Presenter - Commercial Vehicle CMS, Cheek, T.; Grimes, W.; Plant D., World Reconstruction Exposition 2023 (WREX2023), Orlando, FL, 2023
- Instructor - Accessing and Interpreting Heavy Vehicle Event Data Recorders, SAE Course C1, Appleton, WI, 2023
- Instructor - Advanced Applications of Heavy Vehicle EDR Data, SAE Course C1901, Appleton, WI, 2023
- Presenter - Commercial Vehicle ADAS: Evolution, Performance Testing & Applications, Cheek, T.; Grimes, W.; Plant, D.; NAPARS Seminar September 2023
- Instructor - Accessing and Interpreting Heavy Vehicle Event Data Recorders, SAE Course C1022, Fontana, CA, 2023
- Instructor - Advanced Applications of Heavy Vehicle EDR Data, SAE Course C1901, Fontana, CA, 2023
- Presenter - Recon-3D User's Group on using Recon-3D tool, online 2024
- Instructor - Advanced HVE, The HVE Forum in Berkley, CA, 2024

PUBLICATIONS & PRESENTATIONS

- "Field Application of Photogrammetric Analysis Techniques: Applications of the FOTOGRAM Program," SAE Paper No. 861418, Society of Automotive Engineers, Detroit, Michigan, September, 1986.
- "Computer Animation Techniques for Use in Collision Reconstruction," SAE Paper No. 920755, Society of Automotive Engineers, Detroit, Michigan, February, 1992.
- "Classifying the Elements in a Scientific Animation," SAE Paper No. 940919, Society of Automotive Engineers, Detroit, Michigan, February 1994.
- "Using ATB in Collision Reconstruction," SAE Paper No. 950131, Society of Automotive Engineers, Detroit, Michigan, February 1995.
- "Analysis of Acceleration in Passenger Cars and Heavy Trucks," SAE Paper No. 950136, Society of Automotive Engineers, Detroit, Michigan, February 1995.
- "Programming FORTRAN Applications For HVE," SAE Paper No. 960889, Society of Automotive Engineers, Detroit, Michigan, February 1996.
- "Developing a Crush Profile Estimate by Balancing Impact Forces," SAE Paper No. 970942, Society of Automotive Engineers, Detroit, Michigan, February 1997.
- "Using ATB Under the HVE Environment," SAE Paper No. 970967, Society of Automotive Engineers, Detroit, Michigan, February 1997.

- "Documenting Scientific Visualizations and Computer Animations Used in Collision Reconstruction Presentations," SAE Paper No. 980018, Society of Automotive Engineers, Detroit, Michigan, February 1998.
- "3-Dimensional Simulation of Vehicle Response to Tire Blow-outs," SAE Paper No. 980221, Society of Automotive Engineers, Detroit, Michigan, February 1998.
- "Low Speed Acceleration of the Kenworth T600 Tractor Truck," SAE Paper No. 980366, Society of Automotive Engineers, Detroit, Michigan, February 1998.
- "Low Speed Acceleration of the Freightliner FLD-120 Tractor Truck," SAE Paper No. 1999-01-0092, Society of Automotive Engineers, Detroit, Michigan, March 1999.
- "The Effect of Crash Pulse Shape on Occupant Simulations," SAE Paper No. 2000-01-0460, Society of Automotive Engineers, Detroit, Michigan, March 2000.
- "Low-Speed Acceleration of a Kenworth T2000 Tractor-Truck with Autoshift Transmission," SAE Paper No. 2000-01-0470, Society of Automotive Engineers, Detroit, Michigan, March 2000.
- "The Importance of Crash Pulse Data When Analyzing Occupant Kinematics Using Simulations," WP# 2000-2, Engineering Dynamics Corporation, Beaverton, Oregon, 2000.
- "Extracting Tire Model Parameters From Test Data," WP# 2001-4, Engineering Dynamics Corporation, Beaverton, Oregon, 2001.
- "Heavy Truck Brake Designer Validation Testing," WP# 2005-2, Engineering Dynamics Corporation, Beaverton, Oregon, 2005.
- "Analyzing the Trip-Phase of Soft-Soil Rollovers," SAE Paper No. 2006-01-1558, Society of Automotive Engineers, Detroit, Michigan, April 2006.
- "Extracting Tire Model Parameters from Test Data," SAE Paper No. 2006-01-1399, Society of Automotive Engineers, Detroit, Michigan, April 2006.
- "Accident Reconstruction Analysis," The Claim Adjuster's Automobile Liability Handbook, Chapter 9, West-A Thompson Reuters Business, 2009.
- "Updated Heavy Truck Air Chamber Force Data Charts," Accident Reconstruction Journal, Volume 26, No. 6, November/December, 2016.
- "Evaluation of The Mide Slam Stick X as a Low-Cost Accelerometer and Data Acquisition System for Vehicle Crash Testing," Collision Magazine, Volume 11, Issue 2, February 2017.
- "Motorcycle Crash Testing: Advanced Boot Camp Was Born," Collision Magazine, Volume 11, Issue 2, February 2017.
- "Acceleration Testing of 2016 Kenworth T680 with Automated Manual Transmission in Auto Mode," SAE Paper No. 2017-01-1418, Society of Automotive Engineers, Detroit, Michigan, March 2017.
- "Acceleration Testing of 2016 Freightliner Cascadia with Automated Manual Transmission in Auto Mode," SAE Paper No. 2017-01-1426, Society of Automotive Engineers, Detroit, Michigan, March 2017.
- "Acceleration Testing of 2011 MCI J4500 45 foot Motor Coach," SAE Paper No. 2019-01-0409, Society of Automotive Engineers, Detroit, Michigan, April 2019.
- "Acceleration Testing of 2000 Van Hool 45 Foot Motor Coach," SAE Paper No. 2019-01-0431, Society of Automotive Engineers, Detroit, Michigan, April 2019.
- "Evaluation of the Heavy Vehicle Event Data Recorder for the Freightliner New Cascadia with Detroit Diesel Engines," SAE Paper No. 2019-01-0636, Society of Automotive Engineers, Detroit, Michigan, April 2019.

- "Examination of Detroit Assurance ® 4.0 Video Radar Decision Unit (VRDU) Records for Use in Crash Analysis," SAE Paper No. 2023-01-0009, Society of Automotive Engineers, Detroit, Michigan, April 2023.
- "Testing of Heavy Truck Advanced Driver Assistance Systems and Crash Mitigation Systems," SAE Paper No. 2023-01-0010, Society of Automotive Engineers, Detroit, Michigan, April 2023.
- "Examination of Bendix ® Data Recording (BDR) Records for Use in Crash Analysis," SAE Paper No. 2023-01-0012, Society of Automotive Engineers, Detroit, Michigan, April 2023.
- "Combination Vehicle Sway-Mode Stability Test Data Compared to Simulations", WP-2024-3, Engineering Dynamics Company, LLC, Severna Park, MD, 2024.
- "Simulation of Vehicle Speed Sensor Data for use in Heavy Vehicle Event Data Recorder Testing", SAE Paper No. 2024-01-2889, Society of Automotive Engineers, Detroit, Michigan, April 2024.

CONTINUING EDUCATION

- Accident Investigation Practices Subcommittee Workshop I, SAE, 1985
- Analytical Reconstruction of Automobile Crashes Using a 3-D Simulator, SAE Seminar 1987
- Accident Reconstruction Photogrammetry Workshop, SAE, 1990
- Commercial Vehicle Accident Investigation and Reconstruction, Arkansas State University, 1993
- Automobile Vehicle Dynamics, SAE Seminar 1994
- Low Speed Rear Impact Collision TOPTEC, SAE, 1994
- Optics, Vision and Automotive Engineering, SAE, 1995
- The 1995 ATB Model User's Colloquium
- Mechanics of Heavy-Duty Trucks and Truck Combinations, UMTRI, 1995
- Sensor Design for Automobile Air Bag Systems, SAE, 1995
- Biomechanics of Impact, AAAM, 1995
- The 1996 ATB Model User's Colloquium
- Low Speed Collision TOPTEC, SAE, 1996
- Heavy Vehicle Underride Protection TOPTEC, SAE, 1997
- The 1997 ATB User's Group Conference
- Airbag Design and Performance TOPTEC, SAE, 1997
- Side Impact TOPTEC, SAE, 1998
- Occupant Protection TOPTEC, SAE, 1998
- Crash Data Recorder - Vetronix Corporation CDR Training Seminar, 2000
- World Reconstruction Exposition 2000 (WREX2000), Texas A & M, 2000
- Braking Performance of Heavy Commercial Vehicles, SAE, 2000
- Theoretical and Applied Vehicle Dynamics, EDC, 2001
- Accident Reconstruction TOPTEC: Special Topics, SAE, 2001
- Passenger Vehicle Rollover TOPTEC: Causes, Prevention and Injury Prevalence, SAE, 2002
- SATAI Spring Conference, 2003
- Institute of Police Technology and Management, CDR Tool - User Certification Course, 2004

- Arc Second Incorporated, Operation & Application of the Vulcan measuring system, 2004
- The 2004 ATB User's Group Conference
- Detroit Diesel Training Center,8876 DDEC Reports/Data Extraction, 2004
- CDR Data Analyst Course, 2006
- iWitness Close Range Photogrammetry Training, Photometrix Pty Ltd., 2007
- Caterpillar Electronic Technician (ET) Course, 2008
- CDR Technician Course, 2008
- CDR Data Analyst Course, 2008
- Human Factors in Traffic Crashes, 2009
- FARO Focus 3D Training Class, 2013
- Institute of Police Technology and Management, Online Bosch CDR Technician, 2014
- Preserving and Analyzing Information from Heavy Vehicle EDRs, Northwestern University, 2015
- Accessing and Interpreting Heavy Vehicle Event Data Recorders, SAE, 2015
- International Association of Forensic and Security Metrology Annual Conference, 2015
- The World Reconstruction Exposition 2016 (WREX 2016), Orlando, Florida, May 2-6, 2016
- ARC-CSI Crash Conference, Las Vegas, NV, 2016
- Digital Forensics of Heavy Vehicle Event Data Recorders, The University of Tulsa, Tulsa, OK, 2016
- Reconstruction and Analysis of Rollover Crashes of Light Vehicles, SAE, 2016
- Vehicle Crash Reconstruction Methods, SAE, 2016
- Accessing and Interpreting Heavy Vehicle Event Data Recorders, SAE, 2016
- Commercial Vehicle Braking Systems, SAE, 2016
- Applying Automotive EDR Data to Traffic Crash Reconstruction, SAE, 2016
- Vehicle Dynamics for Passenger Cars and Light Trucks e-Seminar, SAE, 2016
- Hands-on Heavy Duty Communications Protocols and Programming, The University of Tulsa, Tulsa, OK, 2016
- sUAS Drone Pilot Ground School/Flight Proficiency, 2017
- Pix4D User Workshop, Pix4D, San Rafael, CA, 2017
- Pix4D Intermediate User Workshop, Pix4D, San Rafael, CA, 2017
- Preserving and Analyzing Information from Heavy Vehicle EDRs, Northwestern University, 2017
- FARO Scene 7 Update Training, 2017
- Accessing and Interpreting Heavy Vehicle Event Data Recorders, SAE, 2018
- Applying Automotive EDR Data to Traffic Crash Reconstruction, SAE, 2018
- The Virtual CRASH Interface, vCRASH Academy, 2018
- Simulation Basics, vCRASH Academy, 2018
- Reconstruction and Analysis of Motorcycle Crashes, SAE, 2018
- Virtual CRASH 3-Day training class, Gainesville, FL, December 2018
- Human Factors for Traffic Crash Reconstruction, Crash Safety Solutions, 2019
- Comprehensive Air Brake Systems Interactive E-Training Program, Bendix, March 2019
- Comprehensive Air Brake Systems (3-Day) Training Program, Bendix, April 2019
- Basic Tire Mechanics and Inspection, SAE, 2019
- Tire Forensic Analysis, SAE, 2019
- Accessing and Interpreting Heavy Vehicle Event Data Recorders, SAE, 2019

- Advanced Technology Training of Higher-level Driver Assistance & Safety Systems, Including Bendix Diagnostic Software, Bendix, May 2019
- Photogrammetry and Analysis of Digital Media, SAE, 2019
- Photogrammetry 4 Forensics, ai2-3D Forensics, 2020
- Applying Automotive EDR Data to Traffic Crash Reconstruction, SAE, 2020
- Obtaining Chip-level Data from Modules, NAPARS, 2020
- Analysis of ECM Data in New Freightliners, NAPARS, 2020
- Accident Reconstruction, The Autonomous Vehicle and ADAS, SAE, 2020
- sUAS Crash Investigation training, Aerial metrics, 2021
- Pix4D for Crash and Crime Scene Investigation, Pix4D, 2021
- Diamond Logic Builder Level 2 Retail Course (8982), NAVISTAR, 2021
- Applying Automotive EDR Data to Traffic Crash Reconstruction, SAE, 2021
- Applied Vehicle Dynamics, SAE, 2021
- Forensic Photography Symposium, 2022
- Heavy Vehicle Forensic Mechanical Inspection for Collision Investigators, Northwestern University for Public Safety, 2022
- World Reconstruction Exposition 2023 (WREX2023), Orlando, FL, 2023
- Recon-3D Training Course, R3D, 2023
- Heavy Vehicle EDR Update, NAPARS, 2023
- Autonomous Technology in Long-Haul Trucking, SAE, 2023

Appendix D:

Mecanica Fee Schedule

MECANICA SCIENTIFIC SERVICES

Fee Schedule (effective February 1, 2024)

ACCIDENT RECONSTRUCTION SERVICES:

Jason Arst, PE	**$370.00/hr**	**Jonathan Balasa***	**$325.00/hr**
David Daren, PEng	**$425.00/hr**	**Christian Fernandez, EIT***	**$245.00/hr**
Ann Grimes, MSME*	**$235.00/hr**	**Wesley Grimes, PE**	**$390.00/hr**
John Grindey	**$460.00/hr**	**Bradley C. Higgins**	**$335.00/hr**
John Isbister	**$345.00/hr**	**John Kolter**	**$295.00/hr**
Mark Leonard	**$370.00/hr**	**Kristina Lombardi***	**$285.00/hr**
Henry Ramirez	**$325.00/hr**	**Christopher Romo, MSME, EIT**	**$330.00/hr**
Henry Scarnecchia, PE	**$405.00/hr**	**John C. Steiner**	**$455.00/hr**
Henry Schmoker, EIT*	**$305.00/hr**	**Steven Tuskan**	**$365.00/hr**

FORENSIC MEDIA ANALYSIS:

David Gifford	**$315.00/hr**

TECHNICAL/MECHANICAL SERVICES:

Michael E. Ashley	**$265.00/hr**
Daryl R. Klomp	**$235.00/hr**

SUPPORT SERVICES:

CAD/Media Designer	**$235.00/hr**
Forensic Media Analysis	**$315.00/hr**
Forensic Animator	**$365.00/hr**
Mechanical Fabrication	**$120.00/hr**
Technical and Research Support	**$195.00/hr**
Non-Technical Case Support	**$80.00/hr**

Hourly Rates include time spent in the research, analysis, and testimony on a specific assignment. Rates also apply to any required deposition, arbitration, and trial testimony. There are no minimum time charges for expert testimony. The above hourly rates do not include expenses. Expenses typically include mileage, photographic and video costs, courier expenses, copying expenses, exhibit preparation expenses, and rental of required specialized equipment. Outside expenses are billed at our cost.

A Retention Letter is required before any file is opened. Retaining Mecanica Scientific Services Corp. does not automatically include the right to designate the engineers as expert witnesses. Expert Designations are not to be sent out until the material has been reviewed and the individual engineer has agreed to be named.

*Volvo/Mack Data Imaging Services and consulting is $300.00/hr.

Appendix E:

Testimony List of Wesley Grimes

Wesley Grimes, P.E. - Mecanica Scientific Services

List of cases where deposition testimony was given:

Case Name	**Client Represents**	**State**	**Date**
Carlos Rodriguez, et al. vs ProPetro Services, Inc.	P	UT	1/16/2012
Robbins, et al. v. Lading	D	IL	3/16/2012
Carranza v. Con-Way Truckload, Inc.	D	AZ	7/16/2012
Kovalcik v. URS, et al.	D	GA	3/7/2013
Schor v. Pacer	D	FL	5/29/2013
Hays vs. DeAngelo Bros.	D	KS	1/10/2014
Canaday v. Ford Motor Company, et al.	D	SC	6/12/2014
Stewart v. Ford Motor Company	P	WV	9/4/2014
Bruno v. Landstar	D	AZ	10/29/2014
Creelman and Grogan v. State	D	AZ	6/25/2015
Ying Mu v. Waddell Concrete Construction	D	AZ	9/1/2015
Straub v. Infinity Insurance Company, et al.,	D	AZ	11/14/2017
Jensen v. National Interstate	D	AZ	4/17/2018
Parsons v. Fotheringham	D	AZ	12/5/2018
Bartley v. Blackwell's et al.	P	GA	11/10/2020
Leggions v. Chen, et al.	D	AZ	2/8/2023
Yap v Arvizu, Loomis	D	CA	3/10/2023
APS adv McClanahan	D	AZ	3/26/2024

List of cases where court testimony was given:

Case Name	**Client Represents**	**State**	**Date**
Bruno v. Landstar	D	AZ	3/12/2015
Creelman and Grogan v. State	D	AZ	2/1/2016
Gecosala v. Sunrise Trucking	D	AZ	10/31/2019
Jensen v. National Interstate	D	AZ	12/13/2019
Bartley v. Blackwell's et al.	P	GA	5/6/2022
Gerardo Sanchez v. State of Arizona	D	AZ	8/4/2022